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Radium, the Metal of Mystery

How It Is Obtained--Its Strange Powers and Probable Uses in the Future

By R. Rutherford

Evolution of Radio-Active Substances

Luminosity of Organic Beings, such as fire flies, marine insects, and numerous other animals emitting phosphorescent light—observed by the earliest inhabitants of the earth.

Phosphorus—discovered by Casciarlo, a Bologna shoemaker in 1602.

Uranium, forming uranite pitch-blende—discovered by Klaproth, a German Chemist, in 1782.

Fluorspar—discovered by Brewster in 1832, named by Stokes in 1852.

Becquerel radiations (emanating from uranium) discovered and named by Prof. Henri Becquerel, member of the Institute of France in 1896.

Polonium—discovered by Mme. Sklowdowska Curie, and named by her for Poland, her native land, in 1898.

Radium—discovered by M. Pierre Curie and Mme. Sklowdowska Curie in 1898.

Radium is a substance that gives off heat and light incessantly without perceptible waste or diminution of power. It comes from the earth and is extracted from ore on the same principle that gold and silver are extracted from ore. Because of its wonderful property of giving forth such enormous energy, all of its own creation and without any known outward incentive, it has been termed the "wizard metal." Though often called a metal, radium has never been secured in metallic form. It looks very much like alum or borax when crushed, and its usual form is as a chloride or bromide.

Seeming to burn forever, without ever consuming itself, to give forth light eternally without ever weakening its force, radium has baffled the scientific world, set at naught scientific theories and doctrines that men have been taught for generations and caused speculations without limit as to future possibilities.

IMPARTS ITS POWERS TO OTHER SUBSTANCES.

One of radium's most wonderful properties is its ability to impart its properties of light and heat emission to other substances. Thus a piece of wood, or metal, or substance of nearly any kind may be rendered radio-active—that is, possessed of the activity or powers of radium—by being subjected to the emanations of radium, something on the same principle that a person may make his fingers luminous by rubbing them on a parlor match. This imparted power, however, is not everlasting, but may endure for days.

MAY BE FUTURE SOURCE OF LIGHT AND HEAT.

Of course, such a phenomenal discovery as that of radium has led to dreams of a time when we may place a piece of radium in our home and thereby provide light and heat for ourselves as long as we live, and

Radium on Exhibition in Paris

for our children as long as they live, and for our children's children, and their children, and so on down the line of posterity

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forever, without the necessity of ever buying another ton of coal or paying another gas bill. And our neighbor, who might not be so fortunate as to possess some radium, might send in a couple of bricks or a piece of iron to be "charged" with radio-activity enough to last for heating and lighting purposes for several days, after which the bricks or iron could again be rendered radio-active by again being exposed to the radium, without ever detracting from the original source of heat and light.

Such hopes at present seem a little extravagant, but still the partial realization of the dream does not appear impossible, nor half as improbable as a short time ago the discovery of a substance so strange as radium would have been regarded.

RADIUM JEWELRY WOULD BE RESPLENDENT.

Radium is now more valuable than diamonds. It is worth about three million dollars a pound, or more than three thousand times its weight in gold. Radium is more valuable than diamonds because at present it is much scarcer than diamonds and because it is more brilliant than diamonds. Diamonds reflect the rays of extraneous lights. Radium creates its own light and gives forth its own rays independent of outward objects. Thus when radium jewelry becomes popular diamonds will have to be relegated to the rear. A woman with radium hair ornaments, shining like electric lights from her head, will be the envy of the ballroom. A radium scarf-pin would light its wearer's way in the darkness, and in each instance the glow of the gem would never grow dimmer and would shine on forever as long as there were a grain of it left. It is possible that this may become one of the principal offices of radium until it is more plentiful, when, of course, it would cease to be prized for ornamentation.

Radium is at present very scarce. It is estimated that there are not more than three pounds in all the world. It is very difficult to obtain under existing conditions, M. Curie declaring that it requires eight tons of ore to produce one gramme of pure radium.

ABUNDANCE OF RADIUM MAY EXIST.

Radium, however, may not be as impossible as some would lead us to believe. Like everything that is only partially known, it is shrouded in a great deal of mystery. It is but natural that its discoverers should try to make it appear as rare as possible that great values might be attached to the small amount now in existence. The Curies of Paris have almost a monopoly on radium, and very little is possessed outside of their laboratory. Fabulous prices have been paid for the little that has found its way to America and other parts of the world. But if two people even with the genius of the Curies can acquire enough radium for laboratory uses, several million other people, including many brilliant minds, may be able to increase the world's supply. For now everybody is hunting radium ore, and in several instances their efforts have met with success. It has been found in several places in America and Europe, and with improved methods of extracting the valuable substance, which are sure to result in time, it does not seem improbable that all of us after a while may be familiar with the "wizard metal" and its strange powers.

Deep down in the earth there is believed to be great quantities of radium. Radio-activity has been discovered recently in a great number of mineral springs; the air from all deep borings in the earth is believed to be radio-active.

Radium ore has been found in a mine in Barringer's Hill, Llano county, Texas; Prof. Alexander H. Phillips, of Princeton University, has discovered radium in carnolite, an ore found in Utah and other of the Rocky Mountain states. Pitchblende, from which radium is extracted, is found in Bohemia, Saxony, Cornwall, Colorado and other places. Specimens from Denver have been examined recently by Prof. Curie and admitted to be of excellent quality. At Jachimsthal, Bohemia, are located the uranium mines from which is secured ore that produces fine radium.

Radium is now being manufactured by De Haen, of Selize, near Hanover, Germany, and by Giesel, of Brunswick. New sources of radio-activity are being discovered continually, and the ore is now believed to exist in vast quantities in the earth.

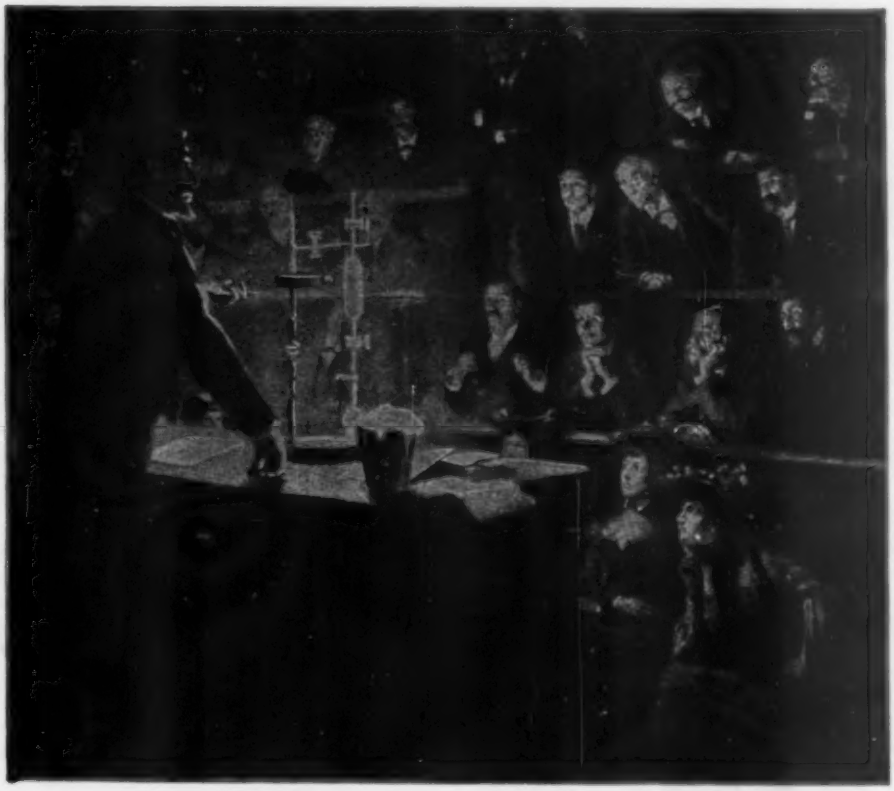
EASY METHOD OF EXTRACTION SOUGHT.

Many chemists at present are at work endeavoring to discover a single reaction by which the radium may be easily separated from the dross. The recent discovery that the gases escaping from radium changed to helium has led to the supposition that the order of things may be reversed, and radium produced from helium. It is not likely that scientists will long permit the earth to retain the secrets of radium, since the knowledge of its existence is once known. Already a cablegram from Paris

announces the discovery of a new process of extraction that will materially cheapen the precious metal.

Electrical methods are employed in detecting the presence of radio-active substances. The instrument used by the Curies is exceedingly sensitive, a million times more so than chemical analysis. Five thousand times the amount of radio-activity readily detected by the Curie electrical device would be required to show at all in the spectroscope.

M. and Mme. Curie Explaining the Wonders of Radium at the Sorbonne



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The radium possessed by the Curies is extracted at the Curie works near Paris from ore that comes from the uranium mines of Jachimsthal, Bohemia. Uranium is an alkaline salt of fluorescein obtained as a brownish-red substance, which is used as a dye. It is so called from the peculiar yellowish-green fluorescence (resembling that of uranium glass) of its solutions. The ore from which uranium is extracted is pitchblende. This is essentially an oxide of uranium with slight mixtures of other substances. It is of a dull black color, and is infusible before the blowpipe, except with the use of borax, with which it fuses into a dull yellow glass. After the uranium is extracted from the pitchblende a lumpy, yellowish powder remains. From this powder radium is produced. The powder refuse was for many years regarded as waste and people were hired to carry it away. Now it is considered more valuable than the original uranite ore. The powder is shipped to the radium works in Germany and to the Curies in France.

HOW RADIUM IS MINED.

The extraction of the radium is begun by crushing the powder and roasting with carbonate of soda. After washing, the residue is treated with diluted sulphuric acid; then the sulphates are converted into carbonates by boiling with strong carbonate of soda. The residue contains radium sulphate, which is an exceedingly insoluble salt. The

soluble sulphates are washed out, and the residue or insoluble portion is easily acted upon by hydrochloric acid, which takes out, among other things, polonium and actinium. Radium sulphate remains unattacked, associated with some barium sulphate. The sulphates are then converted into carbonates by treatment with a boiling strong solution of carbonate of soda. The carbonates of barium and radium are next dissolved in hydrochloric acid and precipitated again as sulphates by means of sulphuric acid. The sulphates are further purified and ultimately converted into chlorides, until about fifteen pounds of barium and radium chloride are obtained by acting upon one ton of crushed pitchblende. Only a small fraction of this mixed chloride is pure radium chloride, which is finally separated from barium chloride by crystallization, the crystals from the most radio-active of the solutions being selected. In this way the crystals ultimately obtained are pure radium chloride of a very high degree of radio-activity. This is the work of weeks or months, and the product may not be more than a gramme of radium.

The discovery of the radiations emanating from uranium by Prof. Henri Becquerel, and named Becquerel radiations, led directly to the discovery of radium. These radiations are used as the standard on which the luminous power of radium is based. When radium is said to possess a certain "radio-activity," say 1,000, it means that its radiations are 1,000 times more powerful than the radiations coming from uranium, or 1,000 times more powerful than Becquerel radiations. Higher intensities are produced by further crystallization. This crystallization process is carried on by the Curies themselves in their laboratory. The crude ore is first brought to a radio-activity of 2,000, after which it is further crystallized until it reaches an activity of 100,000, 500,000, and at length 1,500,000, the maximum. The specimens shown in America possess a radio-activity of from 300 to 7,000, none of more than 7,000, and hence afford but a meager idea of the real luminosity of radium. All radium of higher intensity than 7,000 is retained by the Curies for their own use.

RADIUM'S ENORMOUS ENERGY.

Efforts to increase the activity of radium or make it supply its energy at a faster rate have signally failed. If this could be done and the output of energy now being dissipated over several centuries could be concentrated into the space of a few days or weeks, its commercial use would be valuable beyond calculation. It has been estimated that the energy stored up in a grain of radium would be sufficient to raise 500 tons a mile high.

Whence does radium obtain this enormous energy in such unceasing supply? This is the question that has so far defied scientific research. Thomas A. Edison's theory which I noticed in the October issue of Popular Mechanics (Page 147), has many adherents. Mr. Edison and others believe there are rays of vibrations in ether of which man has heretofore had no knowledge, and that these furnish the power of light and heat to radium, just as tungstate or calcium are affected by X-rays. M. and Mme. Curie suppose that the atoms of radium are constantly in the state of slow evolution and transformation. The change is so slow that it cannot be detected in a year, yet the amount of energy educed in the performance is enormous. The most plausible theory seems to be that chemical changes are successively taking place in radium. This causes greater masses of material to be projected spontaneously at enormous velocity. Fresh portions continually take the place of the portions that become inert. As stated in the September issue of Popular Mechanics (Page 23), the old theory that atoms of elements consist of indivisible units of matter has been discarded by many scientists since the discovery of radium. Instead, they believe each atom is a whole stellar system of infinitely smaller, but absolutely identical units.

RADIUM RAYS ARE LIKE X-RAYS.

There are believed to be two kinds of radium rays, one of which seems to possess many characteristics of Roentgen rays. They will penetrate thin plates of aluminum, iron, steel, wood, black paper, etc. "Radiographs" taken of these substances are not unlike X-ray photographs. A radiograph of a lead box possessed by Prof. William J. Hammer shows the box nearly transparent. The radiograph was made by an exposure of nearly twenty-two hours. The rays are nearly non-deviable, as are X-rays. Glass, when in contact with radium, becomes colored. A flask containing radium will be colored to a deep, beautiful violet. Glass X-ray tubes used for some time partake of a like color.

POWERFUL HEAT AND LIGHT EMANATIONS.

Two pounds of radium placed in a room

thirty feet square would illuminate it sufficiently for reading and all practical purposes. One-tenth of a gramme will illuminate sixteen square inches of surface sufficiently for reading.

The heat given out by radium is sufficient to melt more than its own weight in ice every hour forever. In an hour a pound of radium would throw out as much heat as the burning of a cubic foot of hydrogen gas. Scientists tell us radium will never cease to give out this heat and will never be consumed.

Hence it seems that it is only necessary to get a sufficient amount of radium from the many sources already discovered in order to have heat and light abundantly and everlastingly from an apparently never-failing supply.

Besides its other strange manifestations, radium constantly gives off an emanation which seems to be a heavy gas, which can be collected in tiny flasks, measured and weighed and used to display the characteristic properties of radium, but it is not permanent. In about a month it entirely disappears. This, it is alleged, has been found to change to helium gas.

Those who most nearly hold the secrets of radium's mystic powers, however, tell us of many strange things that may hinder the use of radium for light and heat. In the first place, some say, it will never be found in sufficient quantities. Besides, they say, radium and its magic rays are deadly poisonous, yet they tell us it is a cure for nearly all ills that affect the human body. Guinea pigs, mice and other animals have been killed by long exposure to radium rays.

Radium, from what its discoverers assert, seems a thing of contradictions. It burns forever, and yet it is not fire; it will poison and it will cure; it will produce blindness and it will restore lost sight; exposure to its rays creates great sores on the body, and exposure to its rays cures the sores and affections on lupus patients; it will destroy the fur on animals and it will cause the fur on animals to grow more abundantly; it will produce premature death to insects, and it will cause insects to live many times longer than their natural life, and many other of its effects are directly opposing, according to claims that have been made by experts. The different effects are caused by the extent and nature of the exposures. Besides curing lupus patients, it has been declared that radium will positively cure cancer and consumption.

Testing Diamonds with Radium

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Nothing known equals radium for testing diamonds. In its presence the real gems glow like flame, while the spurious diamonds are not affected in the least. The finer the diamond the more brilliantly it shines in radium's presence.

MAY BE AT LAST THE FOUNTAIN OF YOUTH.

It has even been claimed for radium that it may succeed in producing perpetual youth. This results from experiments on insects by which their development was arrested and they remained in their larvae state and lived nearly four times longer

M. and Mme. Curie Finishing a Preparation of Radium

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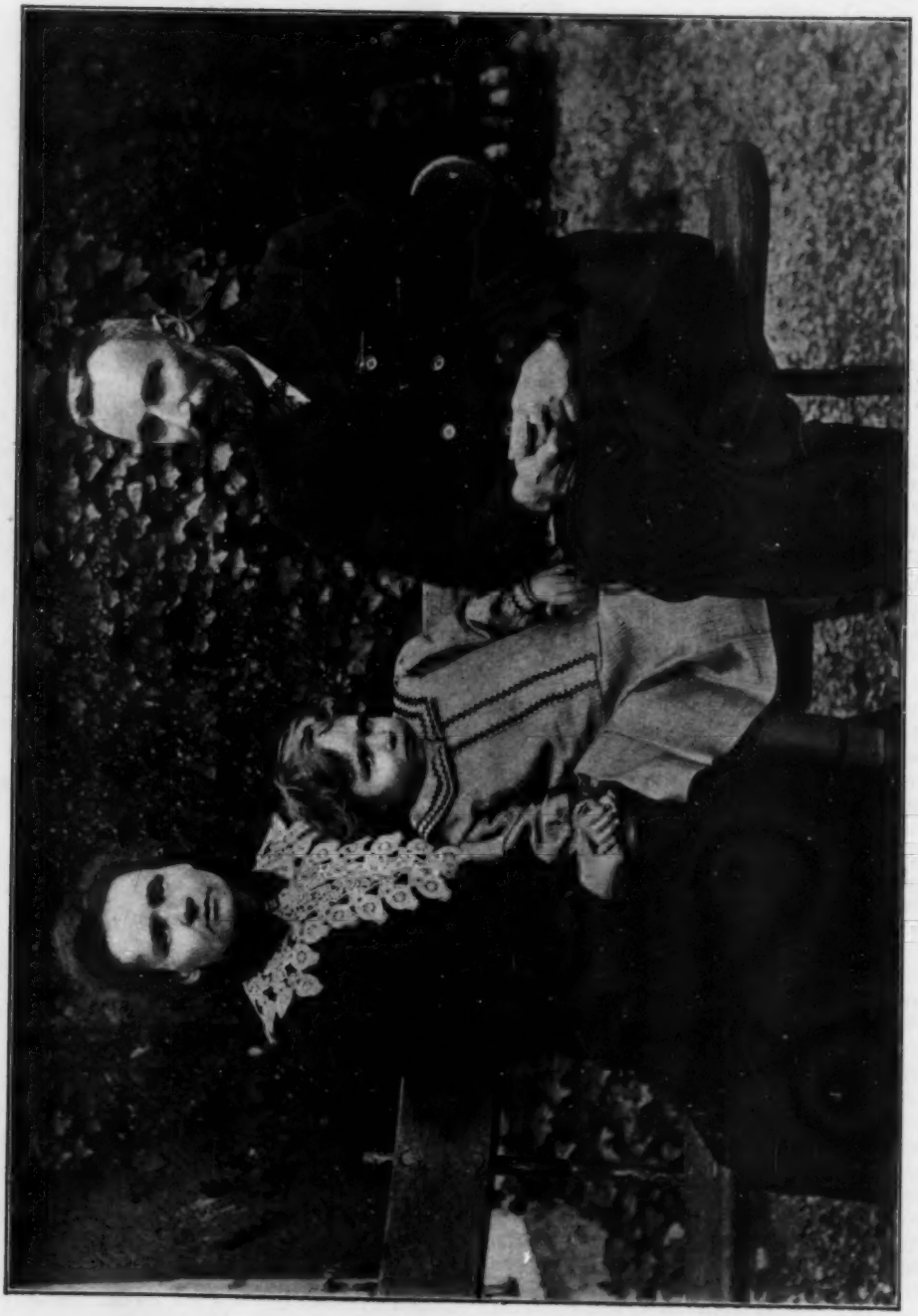


PROFESSOR AND MADAME CURIE
JOINT DISCOVERERS OF RADIUM

than the natural life of the insects permitted to develop into moths. This alleged miracle is regarded by M. Curie to be as remarkable as if a youth should be similarly treated and thereby caused to live nearly three hundred years and all the time retain the appearance of a young man. By advancing the treatment some believe it might cause everlasting life. Radium has been used to cause the growth of unfecundated eggs of sea urchins and to sustain the life through development. Thus it created life from the lifeless. Experiments have shown that it will produce new forms of life, different from any known to science before. Tadpoles, that were treated, failed to produce frogs, but instead developed into strange looking monsters, unlike either the tadpole or the frog.

Thus it is believed by many that this remarkable discovery may hold within its mysterious powers the very secrets of life and death; that it may reveal the secrets of the origin of life, and permit the artificial or chemical production of life; that it may enable man through the treatment of chemical substances as readily to produce a mechanism that breathes and lives as he now manufactures a clock that ticks and measures the hours.

These claims for radium are made by very eminent authorities, many of them by M. and Mme. Curie, themselves, but all of them of course cannot be credited.

Radium is a very mysterious substance—in fact the most mysterious that has ever been discovered or produced and the very fact of its mysteriousness, doubtless, has led to the suspicion of numerous magic powers it might yet possess.

IS RADIUM A PERPETUAL MOTION?

The facts known regarding the strange substance are that it gives out heat and light and a strange gas incessantly, seemingly forever, in undiminishing quantities, without ever losing a particle in weight, without ever depreciating in power. Perpetuity is difficult for the human mind to comprehend and it seems unnatural, as all we have hitherto known in nature has a beginning and an end, but radium's powers seem perpetual. None has so far been able to discover positively that they are not. Prof. Curie thinks it possible that in a thousand million years a gramme of radium might lose one-millionth part of its bulk. Others say a ton might lose an ounce in ten thousand years, but there has never been a perceptible loss in the weight, bulk, or force of radium, on which such estimates could be based.

Therefore radium is more wonderful than perpetual motion for it seems to be perpetual motion and more. The fairy story in our school readers of the machine that makes the sea salt by continuously grinding salt is not half so strange as the true story of radium, the "magic metal" that seems to produce light and heat forever and never loses force or weight.

Parisians are already becoming tired of the auto fad, and are turning eager eyes to ballooning.

A share in a Russian vessel can be acquired by a foreigner only by inheritance, and then only on condition of transfer to a Russian subject within two years after the death of the testator.

Prof. Richards, of Lehigh University, says that the waste gases from a modern blast furnace are capable of developing 10,000 horsepower if utilized in suitable gas engines.

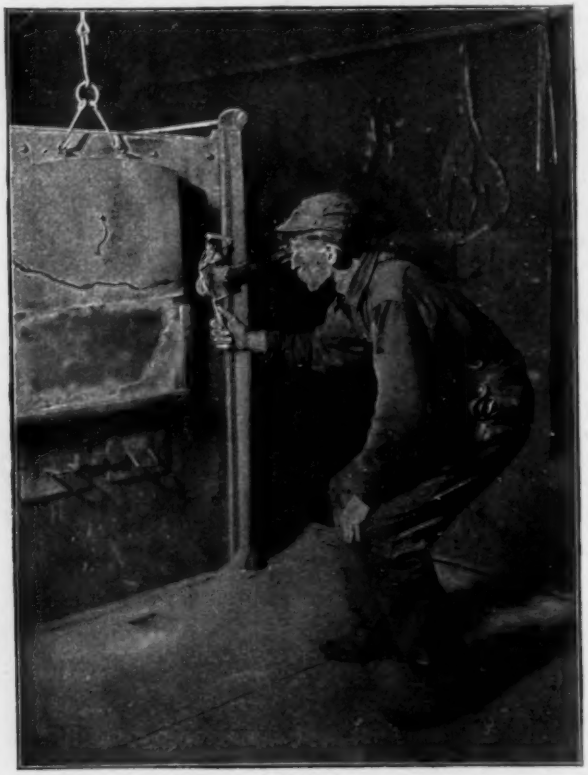
CARRYING WATER IN MEXICO.

In early days of Mexico and Western Texas and even yet in Mexico, the carrying of water is an important problem. Sleds and wagons equipped with barrels are used in some places, but the primitive method and the one now in vogue in many parts of Mexico is the burro and the Mexican water jars. The jars are strapped on either side of the animal's back. Often the water for the entire community is in this manner packed from a well or spring miles away.

How Water is Carried in Mexico

Instrument Shows the Heat of Steel

An instrument has been perfected which shows at a glance how hot a mass of steel is, without using a thermometer, and its accuracy is remarkable. It will not vary 5 degrees in 1,000. The indicator can be used in a great variety of purposes for the lead bath, on a blacksmith's fire, or with a heating furnace, as shown in the illustration.



Heat Gage as Used with a Heating Furnace

A short telescope tube contains an incandescent electric light, having its filament arranged in spiral form. This is connected to an ammeter, and rheostat by means of which any desired current may be switched on the lamp. A table gives the heat equivalent of various degrees of incandescence. When current is on the lamp and the instrument pointed at the heated object, the spiral will appear brighter or darker than the object viewed according to the greater or less amount of current in the lamp. The rheostat is set to the proper current to give the desired heat in the metal, say 900 degrees. When the filament shows no brighter or darker than the metal the object has reached the 900 degrees. The instrument, which may be set to show any desired temperature, is named the Morse thermo gage, and is fully covered by American and foreign patents.

BANQUET IN A SEWER.

Mayors of Iowa enjoyed a banquet in a sewer a short time ago. The subterranean feast was at Waterloo, Ia., whose mayor and city officials acted as hosts. The occasion was the completion of the great work that will give Waterloo one of the finest sewage systems in the country.

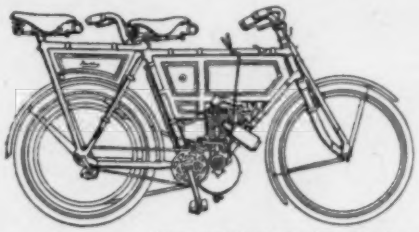
An immense concrete storm drain, built to protect the city from the western water shed, served as the banquet hall. The arched drain is twenty-two feet below the surface of the earth and is in the shape of a letter "D" lying on its flat side. A table 350 feet in length was spread in the center of the arch and 150 mayors of Iowa cities and 200 of the leading business men of Waterloo were seated at it. The speakers were stationed at the ends of the tables and could be distinctly heard by all. Dry Run sewer is 3,585 feet long, twelve feet wide and twelve feet high. Over 6,000,000 pounds of cement were used in its construction and the greater part of the excavation was made through solid rock. Its entire length is through a populous portion of the city.

In changing from the liquid to the solid state and cooling down to lower temperatures, steel crystallizes in planes at right angles to the cooling surfaces and shrinks from 3-16 to 5-16 of an inch per lineal foot.

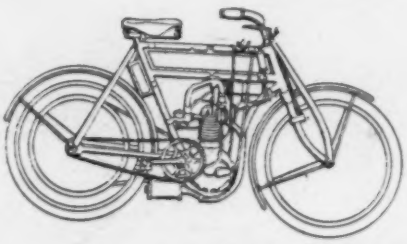
Motor Cycling a Coming Fad

Display of These Machines at Recent London Auto Shows Causes Great Surprise

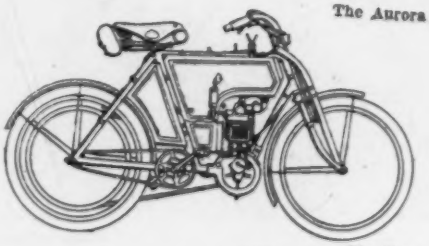
Unless all signs fail the motor bicycle is destined to have its turn as reigning mechanical hobby in 1904. Two notable exhibits have been held in London: the Stanley in Agricultural hall, and the National in Crystal Palace. These shows were ostensibly exhibits of motor cars. They were what the people came to see: instead they found style after style of motor bicycles of every name and description. Their number was even a surprise to the exhibitors themselves. One hundred and twenty were the separate and distinct firms and exhibits of these two-wheeled racers which promise to become as thick as horseflies



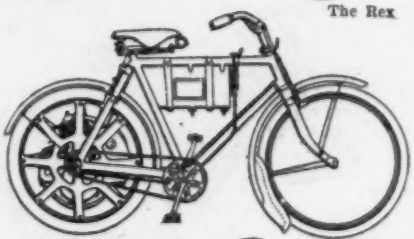
The Bradbury Peerless Tandem



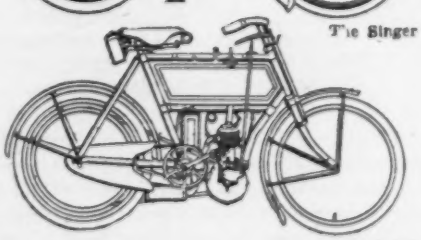
The Aurora



The Rex



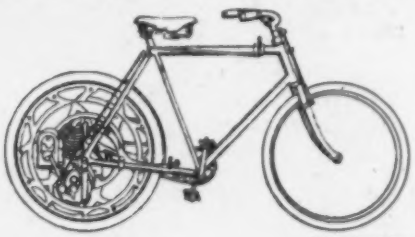
The Singer



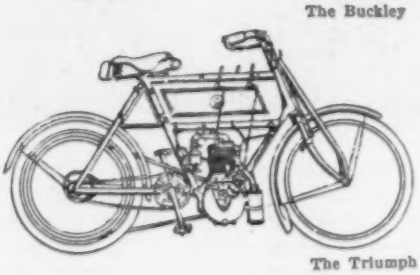
The Ariel

As the bicycle and automobile came to us after having won their spurs in Great Britain, so we may expect the same course to hold good in the case of the motor bicycle.

The few companies thus far building such machines in this country have met with a fair degree of success in producing serviceable machines, but there is no concealing



The Buckley



The Triumph

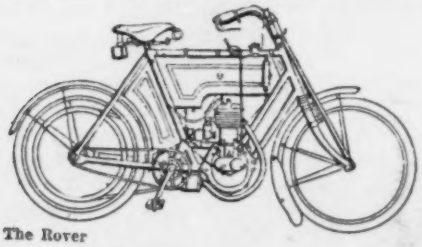
the fact they have yet a lot to learn before the motor bicycle becomes a household necessity. The demand has been fully equal to the supply, however.

Owing to lack of space and the necessity to economize weight the motor bicycles have not been as dignified in their operation as the autos, and the exhaust is painfully disagreeable. They easily get out of repair, owing to the jolting the machines receive, and altogether the American machine has room for much improvement.

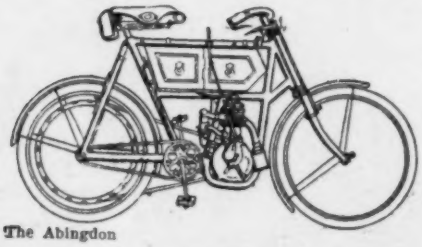
"The motor bicycle displays show several decided tendencies in construction," says the

Motor Age. "One is toward spring forks, these being incorporated in the trussed fork, which is almost universal in England. Another and with less apparent desirability, is toward water cooling. It is probable this will never become general on light machines. Mechanical inlet valves are among the motor improvements, while magneto instead of batteries and coils is a prominent novelty.

Motor tricycles are quite in favor abroad, which on account of their excellent roads, give good satisfaction. Two-speed gears are provided, and special attention is given to securing an effective brake. The illustrations show some of the best types and are taken from the journal quoted.



The Rover

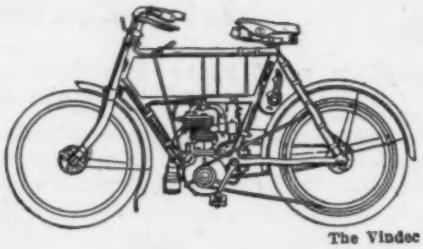


The Abingdon

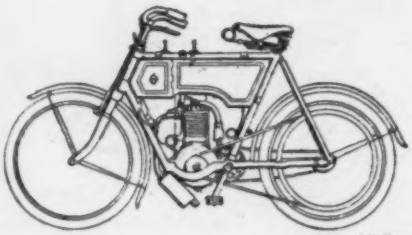
"HELLO" IS UNIVERSAL WHEREVER THE TELEPHONE IS USED.

The telephone has made the word "hello" a universal greeting in every place on the globe where language is spoken by wire. All languages, English, German, French, Spanish and the thousand and one others are transmitted faithfully by the telephone, so that the interpretation of the telephone might be said to be universal. No matter, however, what the nationality of the speaker may be or what vernacular he may employ, every telephone message in all languages is preceded by the great American "hello."

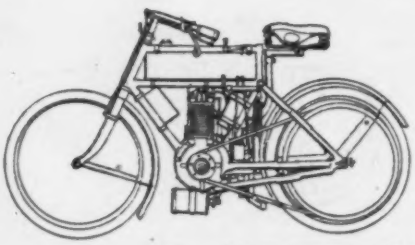
The Pennsylvania railroad has installed a long distance telephone system connecting Pittsburg and Philadelphia, at a cost of $75,000, exclusive of poles. The line will be the most expensive ever built, the wires being copper of unusually large size.



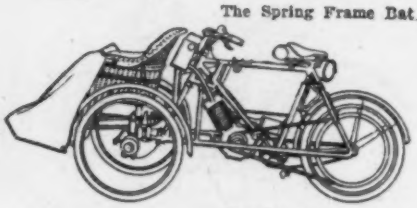
The Vindec



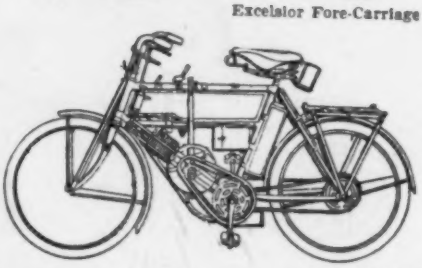
The Alldays



The Spring Frame Bat.



Excelsior Fore-Carriage



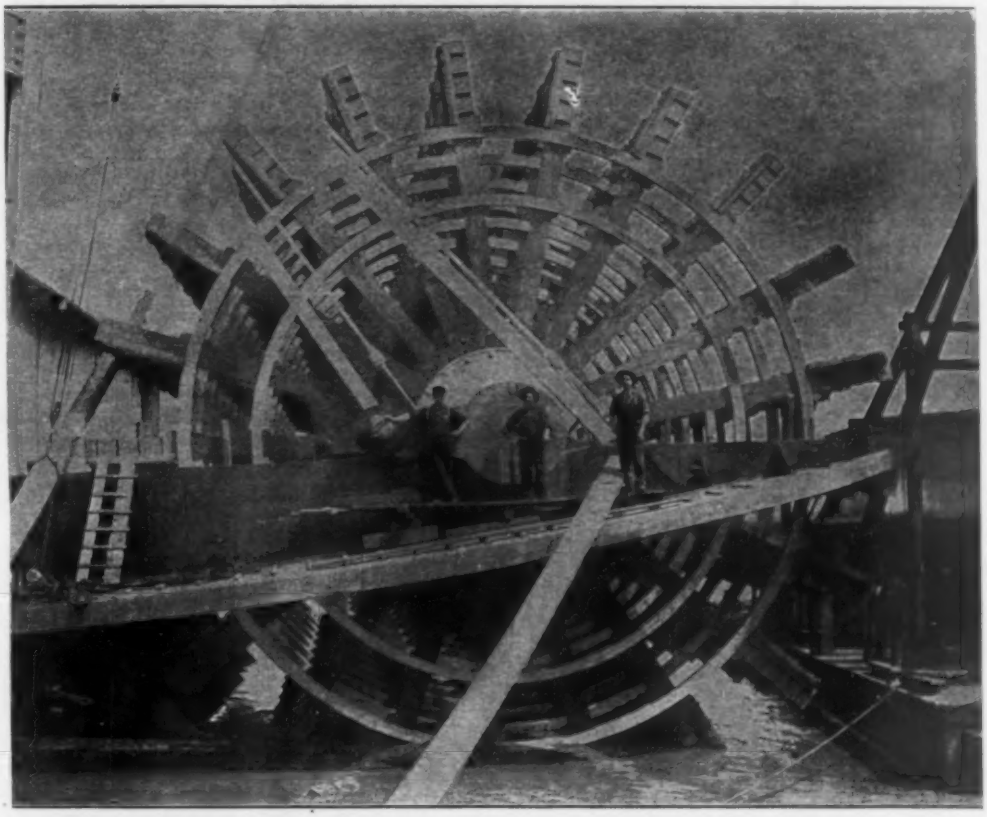
The Humber.

LARGEST CIRCULAR SAW.

The largest circular saw in the world has just been made in Philadelphia. It is 7 feet 4 inches in diameter, bears teeth 4 inches long, and weighs 305 pounds. It will be used to cut pine stumps into shingle bolts.

Enormous Stern Wheel of the Sprague

It Propels the Largest Towboat Ever Built--A New Giant of the Mississippi



Stern Wheel of the Steamship Sprague—40 Feet in Diameter, 4 Feet Wide by 40 Feet Long

Propelling the largest river towboat ever built, the stern wheel of the giant Mississippi river steamer Sprague is probably the most colossal construction of the kind to be found on any waters. The wheel is 40 feet in diameter, equipped with 21 buckets, each 40 feet long by 4 feet wide. The Sprague has just been launched at Dubuque, Ia. An idea of the immense size of the wheel can be obtained from the illustration, which shows the comparatively small stature of the men standing near its center.

The wheel shaft is of hollow forged nickel steel, the outside diameter being 31 inches; diameter of the hole 21 inches at the center and 10 inches at the journal. The length of the shaft is 47 feet 2 inches and it weighs 80,220 pounds. It is fitted with eight cast steel flanges, to which are attached the spokes of the wheel.

The Sprague is employed in taking down river great fleets of coal barges.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

An American manufacturer recently received an order for a lathe warranted to make a chip 1 inch deep, with a feed of ¼ inch, with a speed of 130 feet to 150 feet per minute.

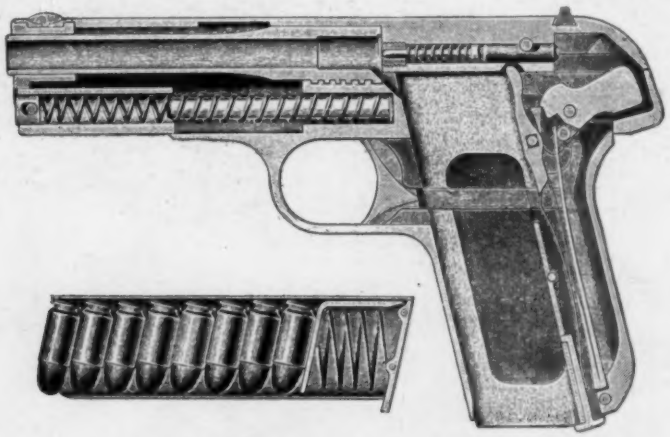
The Magazine Pistol, An Instrument of Death

Deadliest of Fire Arms Seems Almost Animate In Its Ingenius Mechanism

On pulling the trigger the cartridge is fired, the empty shell extracted, a new cartridge loaded into the chamber and the indicator shows that one cartridge less remains in the magazine. All this is done automatically in the twinkling of an eye, in the instant while the trigger is being pressed. Such is the triumph in the manufacture of small fire arms that has been attained in America and that is exemplified in the new Automatic Magazine Pistol, the most deadly weapon known. Firing eight shots without reloading and in quicker succession than is possible with any other weapon outside of the artillery, this little weapon, only seven inches long and weighing but 23 ounces, is a veritable battery within itself. Although it has been on the market but a few weeks, its fame has spread all over the world. While in many localities it has become the pride of the outlaw and the terror of the law-abiding, it has in numerous instances served as worthy protection against culprits and a valuable weapon to the police. More murders can be traced to its death-dealing missiles than to any other source since its dashing debut into the world of crime. True in its aim, fearful in its force and instantaneous in its action, it is unrivaled in the present day as an instrument of death. The magazine pistol has been known to kill a man two blocks away.

The cartridges of the automatic revolver are supplied from a detachable magazine inserted in the handle. They are loaded with smokeless powder. The automatic operation is effected by the recoil of the moving parts, and as a consequence the recoil is so absorbed in being utilized that it has no disturbing effect.

The main parts of the pistol are the receiver, the barrel and the slide. The receiver has suitable guides for the reciprocating slide. The magazine is inserted in the hollow handle from below and there held by the magazine catch. When the catch is released the magazine may be drawn from the handle for recharging. In front of the handle is the trigger guard in which the trigger is located; in the rear and above the handle is arranged in the receiver the firing mechanism, consisting of the hammer, the sear, a safety device and the main spring; also the sear, safety and trigger spring. Upon the barrel are transverse ribs and on the frame are corresponding recesses. These serve to engage the barrel firmly in the closed position.



Showing Interior Construction of Magazine Pistol

The magazine is a tubular holder in which the cartridges are placed, one above the other, resting upon a follower, which is acted on by a spring passing upward. The upper end of the magazine is open to permit the escape of cartridges; the side walls at the rear of the opening are turned inward and engage the rim of the topmost

cartridge to prevent its escape from the magazine when it is pushed forward. The slide of the pistol has been machined out, leaving the solid metal for the breech block. As the slide and breech-block are one solid piece and the slide is slipped on from the forward end, it is impossible for powder-gas or powder to come backward through the arm. The magazine has holes drilled in the sides, which act as indicators to designate the number of cartridges in the magazine.

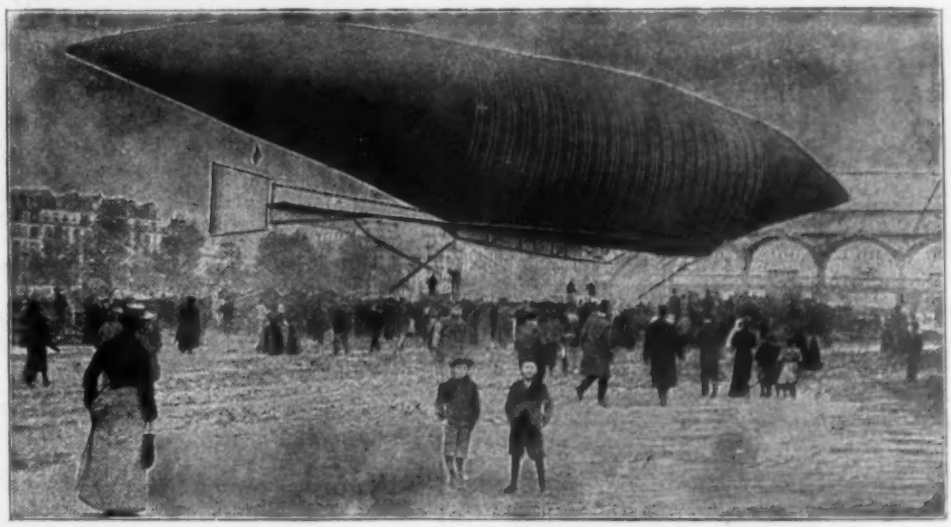
The pistol is provided with a safety device which makes it impossible to release the hammer unless the slide and barrel are in their forward position and safely closed; this safety device also serves to control the firing and to prevent more than one shot from being fired for each pull if the trigger. It consists of a small vertical piece mounted in front of the sear in the receiver, the end of which slightly projects from the top of the receiver; in its raised position when the bolt and slide are closed, it finds a corresponding recess in the bottom of the bolt. In its raised position the safety piece does not interfere with the operation of the trigger, but when the slide is moved rearward, the bottom of the bolt depresses the safety-piece which, in that position, prevents the movement of the trigger from operating the sear, and thus the hammer cannot be released until the slide is again in its forward position, locked to the barrel.

Assembling the Magazine Pistol

Santos Dumont Has Two Rivals

Labaudy Brothers Fly About Over Paris in a Remarkable New Airship

Two new aeronauts, rivals of Santos Dumont, have made their appearance in Paris. They are MM. Pierre and Paul Lebaudy, cousins of M. Jacques Lebaudy, the "emperor of Sahara," who was pictured in the December issue of Popular Mechanics. The Lebaudy dirigible balloon, the "Jaune," recently made a remarkable trip in Paris. It traveled about over the city from Moisson to the Champ de Mars.



The Start

The Lebaudy airship is 183 feet long and 33 feet in breadth. The frame is 70 feet long and nearly 20 feet wide. The car is

Airship Passing Eiffel Tower

16 feet long and five feet broad. It has two sets of steering-gear and two screws worked by a 40-horse-power motor.

A great crowd watched the balloon as it majestically rose, swept past the Eiffel tower and seemed to move in perfect obedience to the aeronaut's guidance until it finally struck a tree on being lowered to the ground and was demolished. The accident, however, is looked upon more as a fault of the steersman than of the airship, and great things are expected of the Lebaudy's next attempt at air navigation.

The Finish

TO PREVENT ECHOES IN CHURCH BUILDINGS.

Editor Popular Mechanics:—Can you kindly give me some information on how to improve the acoustics of halls, churches, etc., by stringing wires from wall to wall. In our church here there is a bad echo that makes hearing very unsatisfactory. The church is plain 30 by 50 feet. The walls are 18 feet high. The ceiling is arched so that in the center of the auditorium it is about 22 feet from the floor to ceiling. The church has no carpet.

A. Lunde, Great Falls, Mont.

—First try a carpet in your church, if nothing more than for the aisles. This alone may stop the echo. If not try hanging draperies at the rear of the hall, when you will in all probability discover that the trouble has ceased. It is absolute bareness of the auditorium that causes the echo. Draperies at the rear will intercept the sound waves before they reach and rebound against the hard bare wall opposite the pulpit. You probably will not need any wires. If you should find that the carpet and the draperies do not give relief, however, you migh experiment with stretching two or three dozen fine wires across the hall from side to side, fastening the wires above the window heads. The best location for them should be determined by the experiment producing the least echo. The kind of wire is immaterial as its office is merely to serve as an obstruction to the sound waves. The acoustic powers of your church might further be improved by erecting a sound board to the rear and above the minister's head so as to throw the sound waves out toward the audience and prevent their going up to the ceiling over his head. The building interior with the best acoustics is shaped nearest like a trumpet. It should be narrow where the speaker stands with no means for the sound to escape above and to the rear, and broadening and widening out in front as the distance from the speaker increases. This is the way all modern theaters are built, notably the Auditorium in Chicago, and the same principle is being followed in the construction of modern churches.

The Massachusetts Institute of Technology the great engineering school of Boston will confer degrees of doctor of engineering and is the first school that has yet been officially established for graduate students of technological subjects.

Here It Is At Last

A Noiseless, Dustless, Horseless Street Sweeper

Now comes a phenomenal genius—John S. Muir is his name—who claims that cities are wonderfully antiquated in having two separate machines for sprinkling and sweeping the streets. He has consequently combined the sprinkler and the sweeper into one huge combination that is supposed to do all the work necessary for keeping streets in perfect condition, as it rolls along at a speed of eight miles an hour, leaving no dust or dirt in its path. Neither does the belated homecomer need fear strangulation from dust as this remarkable machine sweeps by, for this sweeper makes no dust. It sprinkles the dust before it sweeps it, or rather gathers it up into a reservoir and hauls it away.

Steam Street Sprinkler and Sweeper

No horses are employed by this machine to belitter the streets as they are cleaned. The combination street sprinkler, street sweeper, street washer, et al, is operated by steam. It is a kind of an automobile street cleaner. So the man who cleans the streets in the future may boast riding in an automobile. It is a noiseless, dustless, horseless, device.

The machine is equipped with a 10 h. p. valveless steam engine and boiler and a 10-horsepower boiler. It is 15 feet long, 6 feet wide, 7 feet high, and weighs 5,840 pounds. The machine, it is claimed, can do the work of twenty men. The fuel is either gasoline or kerosene, of which 28 gallons can be carried. The sprinkler tank holds 109 gallons.

The two men sitting in the seat of the sweeper are the renowned president and secretary of a company interested in its manufacture looking for a city to adopt the machine for public service. As yet it has not entered into general use, but municipal heads are noted for their stupidity in recognizing ingenious conceptions.

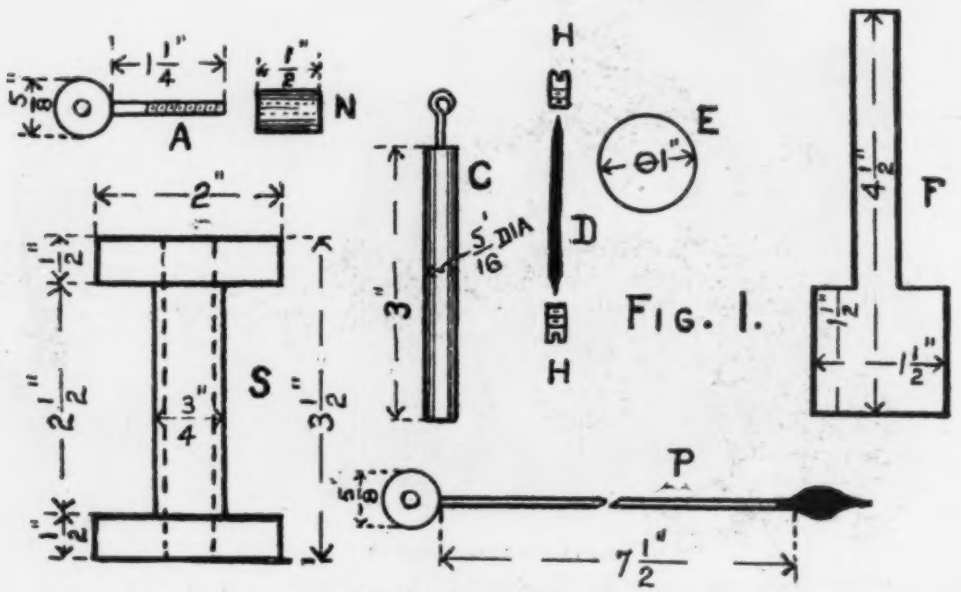
From among the hundreds of letters of commendation received we select the following: A subscriber from Ft. Smith, Ark., writes:

"Popular Mechanics, as the editor says, is 'written so you can understand it.' I work for a power company in this city, and when I receive my magazine every month it's a scramble between the boys to see who reads it first. Seven have already promised to subscribe."

EASY ELECTRICAL EXPERIMENTS

AN AMMETER FOR ELECTRO PLATERS.

The writer recently constructed the ammeter described in the following paper, and its operation has been so satisfactory, it is thought that a description of the instrument will be of interest. Ammeters are often desired for purposes where the instrument may be placed upon a wall, and whose readings need be only approximately correct. The instrument to be described is essentially a wall instrument, and its readings may be relied upon to an accuracy of five per cent.



Showing Parts of Ammeter.

A view of the complete instrument, with the exception of its outer case, is given in Fig. 2, and a view of its several parts is given in Fig. 1.

A hard wood spool of the dimensions shown at S will be required. This may easily be turned on a lathe. A hole ½ inch in diameter should be bored lengthwise through the center of the spool. When this spool is finished, it should be wound full of No. 10 double cotton covered magnet wire. This size of wire is suitable for an instrument whose maximum reading is 25 amperes. If a lower reading instrument is desired, smaller wire may be used. Number 12 wire gives an instrument with a maximumm reading of 15 amperes.

When the coil is wound, fasten the ends tightly, leaving one foot of each end loose, and give it two coats of heavy shellac, and set aside to dry.

Procure a smooth well finished board, 12 inches long, 7 inches wide and ⅞ inch thick. At a distance of 2 inches from the left hand edge, draw a line the whole length of the board, parallel to the edge. Upon this line, with its center 4 inches from the bottom, mount the coil just constructed. The projecting wires should be pushed through two holes in the board so that they stick out at the back, and the coil should lie close against the board. Then two brass straps passing around the spool at the top and bottom, and screwed to the base-board, will secure the spool firmly to the board. The projecting wires may then be brought down to two binding posts at the bottom, which are not shown in the cut.

The coil is to act upon an iron core, which is shown at C, Fig. 1. It is made up of a tight bundle of number 20 B. & S. iron wire. This wire should be very soft and straight, and the bundle should be bound together with strong thread. The central

wire is left projecting at the top to form a hook by which it may be suspended.

Next cut out a piece of sheet brass shown at F. The projecting tongue is to be bent twice at right angles, as shown in Fig. 2, so as to form a support for a small shaft pivoted in bearings which are screwed into the brass support. The tongue is first bent sharply at right angles, close to the back. Then at a distance of ⅜ inch from the end, it is bent down again. A small steel shaft shown at C is next constructed. It is 2 inches long and ground to a fine point at each end, to fit into two conical bearings, in exactly the same manner that the balance wheel of a clock is supported. The shaft may be about 3-32 inch in diameter. In the brass support just described mount the small bearings shown at H. These have conical cups turned on their ends, and are threaded so as to screw into holes drilled in the brass piece F. The shaft should lie at a distance of ⅝ inch from the projecting brass tongue, and should turn with very slight friction indeed. The pivots should be hardened to decrease friction.

Upon this shaft are to be mounted three things. First, the brass pulley shown at E, which is ⅛ inch thick, and has a groove turned in its rim. Second, the brass weight shown at N, and its support A. The latter is made by turning a small brass disc ⅝ inch in diameter, into the rim of which is screwed a projecting brass rod, threaded, upon which screws the weight N. The supporting disc should be provided with a setscrew, so that it may be fastened upon the small shaft in any position.

In a similar manner, a wire pointer shown at P is constructed. It is supported on the shaft by a brass ferrule, and carries at its outer end a black pointer cut from a piece of thin aluminum.

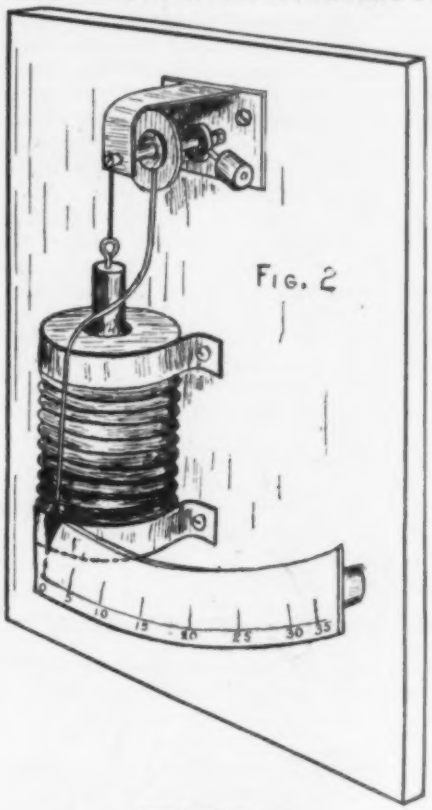
The wheel E makes a driving fit upon the shaft, and should be at a distance of 1 inch from the base board when the brass support is screwed to the latter. The pointer slips on in front of the wheel E, and the counterweight is behind the wheel.

Mount the brass support, with its supported shaft, pointer, and counterweight, at such a height that the shaft is 4 inches above the top of the coil, and so that a vertical line through the rim of the little pulley will pass through the center of the spool of wire.

Then hang the iron core, by a silk thread, so that the thread passes around the brass pulley, and allows the iron core to hang freely with its lower end just inside of the spool of wire. A small brass hook soldered to the rim of the wheel, on its under side, will furnish a convenient means of fastening the thread. The wire pointer will have to be bent so as to clear the spool, and the counterweight adjusted so as to bring the pointer to rest in the position shown. Every thing should swing very freely, and the pointer, when disturbed should come back after a few oscillations, to the same point each time.

A circular scale, cut from a piece of white bristol board, is secured behind the pointer.

To calibrate the instrument it must be placed in series with another standard instrument. The reading of the latter is marked upon the paper scale, and this process repeated for each point desired.



Ammeter Completed.

A neat wooden case may be made, with a glass front, adapted to slip on over the moving parts of the instrument, being secured to the baseboard by two hasps and dowel pins. The instrument should be firmly screwed to the wall in a vertical position.

When a current is sent through the coil it attracts the iron core, drawing it down into the coil. This causes the pointer to move toward the right, lifting the pointer and counter weight. The stronger the current, the further will the pointer be moved. The instrument will work equally well on alternating and direct currents.

GRAMAPHONE RECORDS FOR WIMSHURST MACHINE.

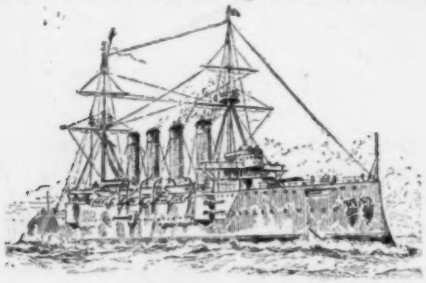
One of our readers, H. E. Hanna, who built the Wimshurst machine from description given in November Popular Mechanics, says: I recently constructed a Wimshurst machine and for the disks I used two 10-inch gramaphone records. The ones I used were badly worn and were useless for musical purposes. Old records may be obtained from most any dealer in gramaphones. A statical machine with disks of this sort should not be placed in the sun or a very warm room, as the disks will warp when subjected to any great heat.

For a condenser I dispensed with the bottles and used a condenser similar to an induction coil condenser, which is more easily constructed than the bottle form. If you will publish the above it may aid some of the amateurs who attempt the construction of the machine.

I am 17 years old. I have constructed a wireless telegraph apparatus which works fine, and have applied for a patent on an ingenious little electrical contrivance by means of which patrons of the rural routes are warned by the ringing of an electric bell, located at a convenient place in the house, when mail has been placed in the mail box.

NEW ENGLISH CRUISER "HAMPSHIRE."

The new English cruiser "Hampshire," which was launched September 24 is 450



Cruiser Hampshire.

feet long, 68 feet beam and draws 24 feet 9 inches of water; it has a displacement of 10,750 tons. A belt of armor tapering from 6 to 2 inches surrounds the vessel. The Shipping World, London, says: "The Hampshire is armed with two 7.5-in.; ten 6-in.; twenty-five smaller quick firing guns, and two submerged torpedo tubes.

OPENS DOORS AUTOMATICALLY.

When the waiter nears the door it opens automatically to permit him to pass and then closes itself, noiselessly and promptly. No longer does the crashing of breaking dishes startle the patrons of hotels and restaurants equipped with this novel device.

Automatic Door Opener.

The waiter is saved the annoyance and risk of using one hand to open the door while he carries a tray of dishes in the other.

The "automatic door opener" is a new invention, which at present is used principally in hotels, restaurants and club houses, but its field promises to spread until it is employed in all kinds of establishments. Its mechanism seems destined to take the place of the hotel footman and the "door boy," now employed in large stores. The hidden springs and levers that manipulate the entrance perform their functions more accurately and untiring than either the footman or "door boy."

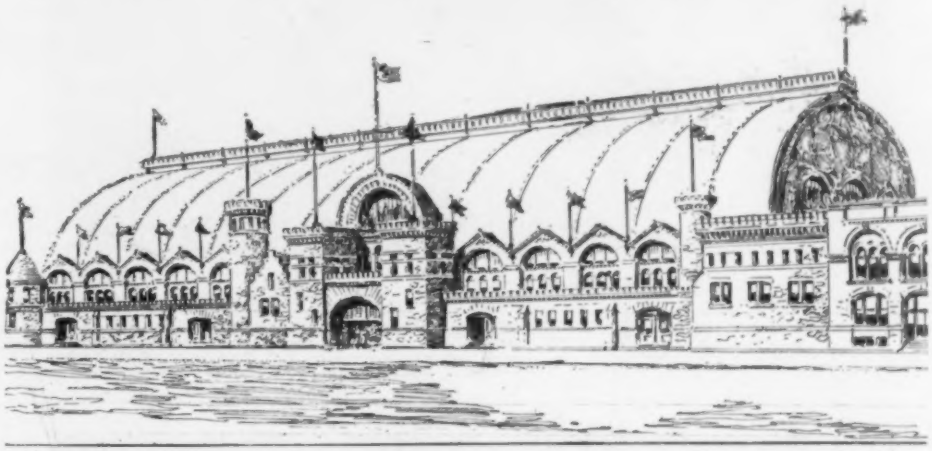
It is the touching of the foot to a platform extending on either side that causes the door to open. This platform is raised about an inch above the floor and is connected by simple levers and a spring concealed underneath.

In the City of New York there are only 737,477 white persons born of native parents.

Greatest Convention Hall in America

Chicago's Coliseum, Where the National Republican Convention Will Hold Forth

The Coliseum in Chicago, which will house the national Republican convention June 21, is the greatest convention hall in America. It has a memorable history, being a transformation of the famous old Libby Prison, which was bodily reproduced for the world's fair. Its present seating capacity of 10,000 will be increased to 15,000 for the occasion of the convention. Spectators, who often have been denied the privilege of watching the deliberations of conventions, will be enabled to witness the proceedings of choosing the Republican party's leader for the ensuing campaign.



The Coliseum of Chicago

The great Coliseum is within four blocks of Lake Michigan. The cool lake breezes will make the atmosphere pleasant on the warmest day. It is ventilated from the roof, under which there are scores of windows. The building is lighted by an immense plant which was installed at a cost of $50,000 and which furnishes light for thousands of electric globes. The acoustics are excellent. The building, while fireproof, is so constructed that it can be emptied in six minutes in case of emergency. There are twelve large exits, consisting of double doors. Twelve thousand dollars are to be expended in improving the structure for the occasion.

This will be the tenth national convention to be held in Chicago, which has thereby earned the title of the Convention City. Abraham Lincoln was nominated in Chicago May 16, 1860. It was here that Ulysses S. Grant was nominated in 1868, James A. Garfield in 1880, James G. Blaine in 1884, and Benjamin Harrison in 1888. General George B. McClellan was nominated by the Democrats in Chicago in 1864, Grover Cleveland in 1884, Grover Cleveland again in 1892, and William J. Bryan in 1896.

GERMAN FUEL BRIQUETTES.

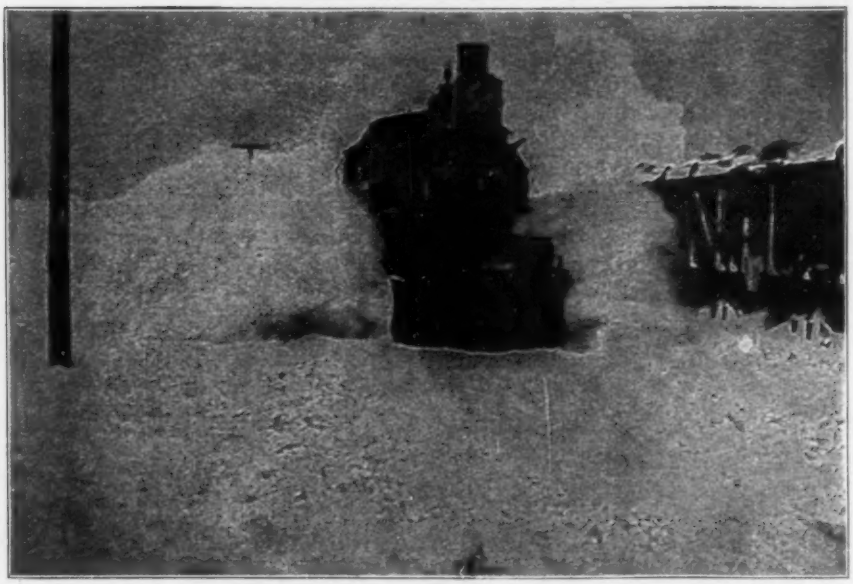
One kind of German fuel briquettes is manufactured by mixing petroleum with rosin and heating; sulphuric acid is then added and the temperature raised to a boiling point. After grinding the slaked lime and the addition of solid fuel, the whole is formed into briquettes. If required for smelting purposes the powdered ore may be incorporated with the mass previous to the briquetting operation. Small lumps of the fuel may be used as fire lighters.

Nickel steel is being used for most of the tension members and pins of the great cantilever bridge now being constructed at Blackwell's Island, New York city.

Automobiles for use on railroads are now the raging fad in Vienna and Budapest, and factories are being crowded to fill orders.

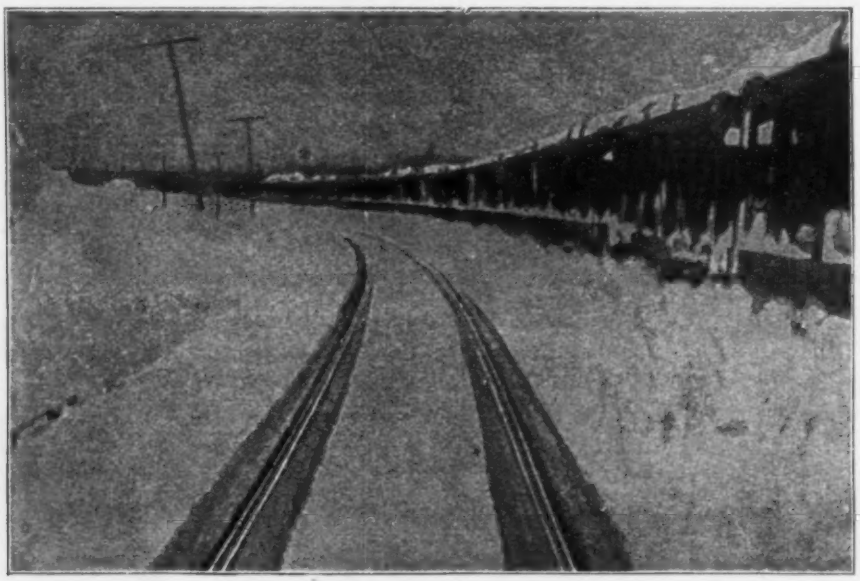
Battling a Blizzard in the West

A Snow Flanger at Work



Track Before Flanger Equipped Train has Passed

The flanger is attached between the front truck wheel and the pilot and is supported directly on the truck. The knives, made to cut the hardest snow are placed about one inch above the rail. The flanger is operated by means of an air cylinder controlled in the engine cab. The passenger train equipped with the compressed air flanger will readily run through 12 inches of hard packed snow and sand. A freight engine will pull its usual winter load under the same conditions with but slight reduction of cars.



Track After Train Has Passed Over Using Flanger

Three Days' Terrible Battle With a Blizzard

Commerce in the Northwest Suspended While the Newest Snow-Fighting Devices Toil in Vain

A terrible battle with snow and cold was fought all over the Northwest Dec. 11, 12 and 13. Trains were wrecked, wires demolished, railway and electric lines rendered impassable, people frozen to death, and for a time the wheels of commerce paused. Many lives were lost in the wrecks caused by the blinding snow storm that buried the tracks before trains could reach a station. Iowa probably suffered the greatest misfortune in this respect. There thirteen lives were lost in wrecks. A train on the Chicago, Burlington & Quincy crashed into the steel girder of a bridge that spans Cedar Creek, killing five and injuring three. Two trains of the Chicago, Milwaukee & St. Paul collided near Adel, Ia., causing three deaths and injuries to a half dozen or more. Five deaths and numerous serious injuries resulted from the overturning of two engines pulling a Baltimore & Ohio train near Piedmont, Va. Several persons were hurt by the overturning of two cars at the C. & P. crossing, Cleveland, O. Elevated trains in Chicago collided because of the inability of the motorman to see the train ahead in the blinding snow. Five persons were frozen to death in Chicago, one while sleeping by a fire. Street cars were derailed and tied up. Hundreds of passengers, unable to reach their homes, were forced to spend the night in hotels, and those who had not the money begged shelter in stores and houses. Railway passengers slept all night in every depot in the city, as nearly all the trains were tied up.

It was during this terrible and widespread devastation from icy blasts and burying snow that all the latest snow fighting devices were brought into play by the different railways. But all of them proved inadequate against such fearful odds. Snow-plows themselves were often stalled, and the snow came down in such overwhelming quantities that the tracks were no sooner cleaned than they were buried again. A new device, the compressed air snow flanger, shown in the opposite page illustrations, performed valuable service before the snow became too deep. These flangers, being attached to the engine, often saved trains from being blocked and probably wrecked. Fewer disasters would probably have resulted if more engines had been thus equipped. The suddenness with which the blizzard came up and the severity with which it raged for thirty-six hours in some sections shows the wisdom of having railroad engines in the northwest equipped with every device that prepares them to battle with such emergencies.

The blizzard was probably most severe in Minnesota, where the thermometer registered 24 degrees below zero, and where fences and barns were completely buried with snow, so that sleds could be driven over them. Nebraska also experienced great loss and intense suffering. Central Wisconsin and Northern Michigan had to suspend business temporarily because of the cold and snow. In Southern Michigan everything was snowbound. Passenger trains were held up for ten hours at New Buffalo. At the Soo everything was frozen up and the car ferries were unable to move.

Weather forecasters declare the storm the severest for this season in twenty years.

A HAND TEN FEET LONG.

Towering 200 feet above the streets of Port Gibson, Miss., a giant wooden hand has pointed upward during 47 years.

Recently it became unsafe, and was taken down and replaced by another. The new hand is ten feet high and was built in Ohio and shipped to Mississippi, where its erection was finally accomplished, but at great risk to the workmen who found it very difficult to handle. It is made of the heaviest sheet zinc, and is expected to endure for 100 years.

The first turbine steamer in Canadian waters of the Great Lakes is building for the Lake Ontario S. S. Co. It will be 260 feet long with a capacity of 1,500 passengers.

Popular Mechanics

"Written So You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.

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POPULAR MECHANICS

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Would you like a research made in the Patent Office of the United States or any other country in which you can take out a patent? Do you want to patent your invention in foreign lands?

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The sales department undertakes the sale of patents and manufacturers desiring additional lines of practical, desirable articles are invited to state their wants. There is a constant demand by manufacturers for patents on articles which are really good and for which a demand exists, or for which a demand can be created.

INTERSTATE INDEPENDENT TELEPHONE CONVENTION.

The annual meeting of the Interstate Independent Telephone Association was held at the Auditorium Hotel, Chicago, December 8 to 10. Much interest was manifested in this convention, and one of the largest gatherings of Independent telephone men ever witnessed in this country was held.

The display of apparatus was unusually fine.

Among the exhibits which attracted especial attention, were those of the Automatic Electric Company, Chicago; Kester Electric Manufacturing Company, Chicago; the Maltby Lumber Company, Bay City, Michigan; the Illinois Electric Company, of Chicago, showing the Peirce patent construction specialties; Frank B. Cooke, Chicago; the Farr Telephone Construction Supply Company, Chicago; the Elliott Addressing Machine Company, of Boston, in charge of their Chicago manager, Mr. A R. Baker; the Standard Telephone & Electric Company, of Madison, Wis.; the Chicago Die & Electric Company, of Chicago, and the Chicago Writing Machine Company, of Chicago, whose gold adjustaphone was one of the handsomest things shown. It is to be presented to President Roosevelt.

The electric roads of the United States last year carried three times the population of the earth.

Popular Mechanics' "written so you can understand it."

Electric Power in the Tropics

SOUTH AMERICAN ELECTRIC POWER PLANT

This installation consists of two Pelton Wheels of 400 horse-power each, driving two 250 K. W. electric generators at 200 revolutions per minute. The wheels operate under a head of 275 feet, the water being supplied through 30-inch pipe 775 feet long. The power is transmitted several miles and used in mining operations.

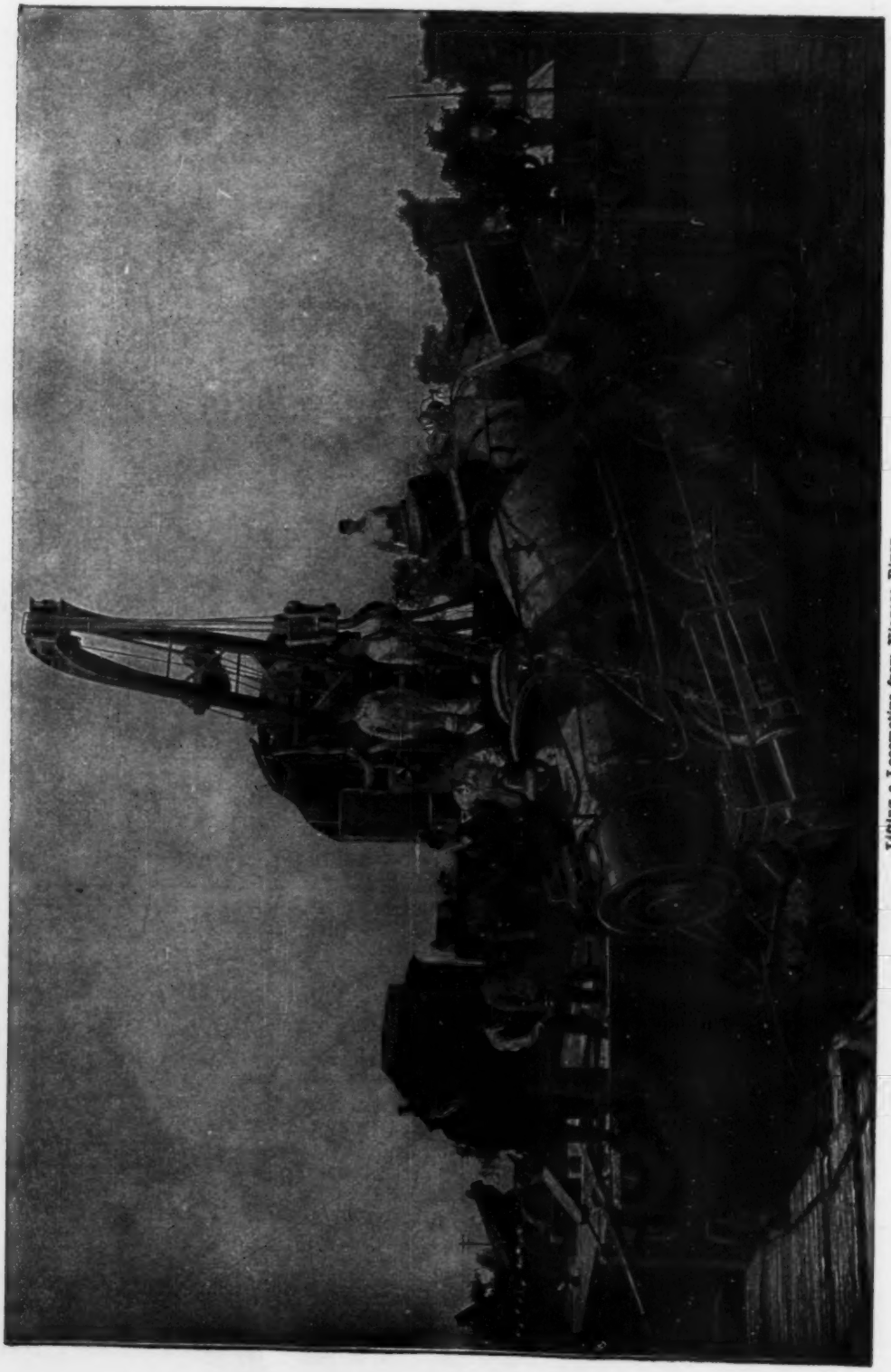
The illustration is of interest, showing clearly the complete pipe system, from masonry settling tank at the top of the line to the power-house. Also is shown the water overflowing the spillway, which is arranged at the end of the canal and near the top of the line. The pipe line is supported on a series of masonry piers, which are carried down far enough to secure a good foundation.

TO ALLOY WITH PHOSPHOROUS.

A method of introducing phosphorous into molten metals has been recommended by Mr. Edwin S. Sperry in the Aluminum World. It is to first coat the phosphorous with copper by immersion in copper sulphate solution. If properly plated the phosphorous sticks can then be handled with perfect impunity; in fact a piece of phosphorous so coppered was laid by Mr. Sperry for several hours in a mid-day August sun without ignition having taken place. Although phosphorous when copper plated is perfectly suitable for alloying just as it stands, it is, nevertheless, better first to make a rich phosphor-alloy and use the latter as the medium for adding phosphorous.

WHAT THE MUSICIAN SEES.

At the conference of musicians, in Dublin, Ireland, it was shown that a pianist has to cultivate the eye to see about 1,500 signs in one minute, the fingers to make about 2,000 movements, and the brain to receive and understand separately the 1,500 signs while it issues 2,000 orders. In playing Weber's "Moto Perpetuo," says the American Inventor, a pianist has to read 4,541 notes in a little under four minutes. This is about 19 per second; but the eye can receive only about 10 consecutive impressions per second, so that it is evident that in very rapid music a player does not see every note singly, but in groups, probably a bar or more at one vision.



Lifting a Locomotive from Niagara River

Lifts a Wrecked Train From Niagara River

Most Astounding Feat Performed by Wrecking Crane at Niagara Falls

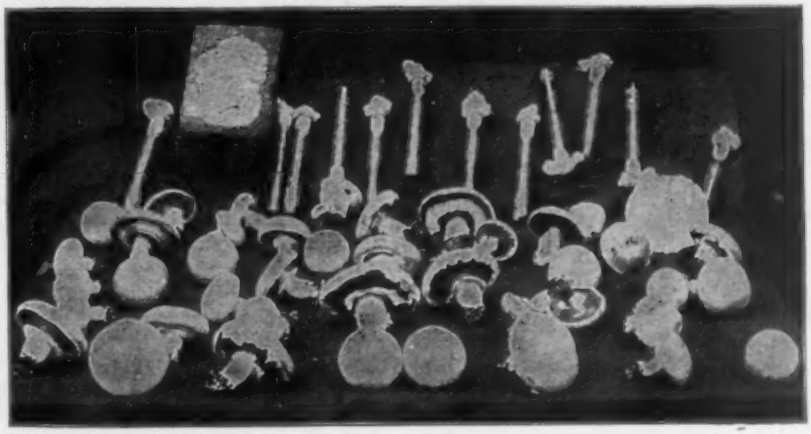
The wrecking crane, described in the November issue of Popular Mechanics, was recently called on to lift a locomotive and cars from Niagara river into which they had plunged headlong from the dock of the Niagara Falls Power Company at Niagara Falls. The wrecking crew of the New York Central Railroad with a powerful steam crane was hurried to the scene. The engine was first rescued, and the photograph from which the accompanying illustration is produced was taken during the process. Chains were placed about the sunken engine and the crane force applied. Slowly the monster on the dock raised the wrecked locomotive and then swung it upon the track.

Many people witnessed the remarkable spectacle, it being the first locomotive to sink in Niagara river and ever do service again. The engine is now at work as usual none the worse for its sensational experience. The cars in turn were lifted out by the wrecking crane and all with some repairing were able to resume their accustomed duties. This is the most significant instance on record to demonstrate the efficiency of machinery of today.

Gardens One Hundred Feet Under a Great City

Ancient Caves Beneath the Town Are Put to Profitable Purpose

St. Paul, Minn., is rapidly acquiring fame as the "Mushroom City." More mushrooms are shipped from St. Paul every year than from any other city in all the Americas. Mushrooms are shipped from there every month in the year, a distinction that no other city can claim. Besides, St. Paul mushrooms are attaining renown for their exceedingly pleasing flavor, leading epicures preferring them to the imported.



Various Stages in the Use of Pure Culture Mushrooms in St. Paul

Underneath the city of St. Paul are many great caves dug there years ago by a wealthy brewer who expected to realize fabulous wealth in using them to store and age beer. The mechanical process of aging beer, now generally in use, was invented just after he had completed the herculean task and hence his labors were all in vain.

Therefore the great subterranean vaults were abandoned and were allowed to lie idle until recently, when a man who understood the growing of mushrooms saw in them another chance of wealth. His scheme was a success, and now nearly all of St.

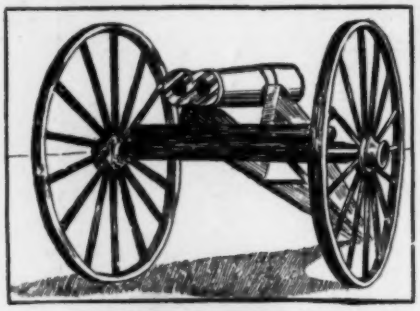
Paul's caves are filled with grown and growing mushrooms.

These caves, which are under the business district, are dug in the sandstone that underlies the entire city of St. Paul. The sandstone pulverizes on being exposed to the elements, but protected by the earth's surface it is as enduring as the hardest rock. The caverns consist in groups of passages, ranging in width from eight to twelve feet, in length from 50 to 300 feet, and are from 6 to 10 feet high. Ventilation holes from the side or top are put in at convenient intervals so that the proper supply of pure air is maintained in all parts of the cave. The caves are at the foot of cliffs which are 150 feet high, very steep, and form a natural wall along the bank of the Mississippi.

The Florists' Review says: The preparation of the beds, the planting of the spawn, the watering, etc., all receive careful attention. After the beds heat and become properly decomposed the spawn is planted at distances of 12 to 15 inches each way, and in four or five weeks after planting the mushrooms appear. Each bed lasts about three months, so that four crops can be gathered each year. During the winter months the caves are heated by stoves to maintain the proper temperature.

JOHN GILLELAND'S DOUBLE-BARRELLED CANNON.

There is now in Athens, Ga., a relic of the war, the queerest cannon ever built. It is known as John Gilleland's double-barrelled cannon. John was a smith. He devised a



The Queerest Cannon Ever Built

machine for the annihilation of Yankees. It consisted of two barrels upon a single carriage. The balls were chained together from the muzzle of one barrel to the muzzle of the other. "She's all ready, gentlemen; come out and see me fire her maiden shot," John said to his friends. They went out. The double-barrelled gun was loaded. "See that clump of timber? Watch me cut it into stove wood," said John. Boom! Swish-h-h! Bim!

John's friends rushed out and picked him up. He had lost an arm. Only one barrel had gone off at the time appointed for both of them to go, and the chain had jerked the flying missile around and sent it exactly in the opposite direction to that expected by the inventor. The gun was retired.

SMELTING IRON BY ELECTRICITY.

Electrotechnische Anzeiger, of Germany, says: "In smelting iron electrically, a plant for which has been installed at Darfo, north of Lake d'Isco, in upper Italy, the metal is reduced direct from the ore by carbon under the heat of an electric arc formed above the mass of mixed ore and carbon. Impurities are dispelled by the use of suitable fluxes. The furnace used is of fire brick and measures 40 inches square. The electrodes consist of two massive carbons protruding through opposite walls of the furnace. The distance between the two is adjustable. At the outset the arc is short, but as the furnace warms up the carbons are separated. The current used is of 2,000 amperes at 170 volts, and is obtained from dynamos driven by turbines. Using as raw material a very pure ore analyzing over 93 per cent of sesquioxide of iron, a capital steel was produced almost completely free from silicon and containing only traces of sulphur and phosphorus. The energy taken is 3,364 horsepower hours per ton of steel, and under favorable conditions it is estimated that the total cost will not exceed $18.60 per ton. The method is considered by Dr. Goldschmidt to be practicable in countries provided by nature with ample water power and pure ores of iron."

"A foundry—be it iron or brass—of any large establishment is almost always looked upon and treated as the necessary evil of the concern. In designing a new foundry an expert ought to be consulted, but not, as is generally the case, brought in at the eleventh hour, when all the plant is laid down and the foundry ready for starting work."

Alarm watches, costing $4, are now being imported from Germany.

Society Dances in a Wine Tank

Largest Vat in the World Emptied of Its Half Million Gallons and Transformed Into a Ball Room

Dancing the cotillion in a wine vat dug from the solid rock is a novelty recently enjoyed by society people of California. Los Angeles and San Francisco's smartest sets, the women gowned in decollete costumes that would have honored the Metropolitan Grand Opera, danced and promenaded on the subterranean floor of the wine vault to exhilarating music furnished by the California Military Band. Walls of the great tank were decorated with silken emblems of many hues. Brilliant electric illuminations made the underground ballroom, that had a short time before been emptied of its 500,000 gallons of wine, glow like a palace in fairyland. One hundred couples danced at one time, while many more looked on.

Largest Wine Vat in the World

The occasion was an invitation ball given in the wine tank of the Asti vineyard on the California Northwestern railroad near San Francisco. Special trains were run from San Francisco and Los Angeles and California's society leaders, including leading business and professional men, were in attendance. The tank in which the dance was held may be regarded as one of the wonders of the mechanical world. It is the largest wine tank ever built, being about ten times the size of the tun of Heidelberg, famed by writers and tourists. It was carved out of a hill of solid stone. A layer of concrete two feet thick was placed over the sides, bottom and top. In this work 1,000 barrels of cement were used, and 6,000 barrels of gravel and fine sand brought from the bed of the Russian river adjoining the Swiss-Agricultural colony on which the vineyard is located.

The tank is 80 feet long, 34 feet wide and 24 feet deep. In preparing the vat for the dancers it was emptied of its half million gallons of wine through a tunnel 200 feet long, extending from the bottom and connecting with the winery. The emptying process consumed 4½ days. Then the vault was thoroughly scrubbed. To refill the tank, after the dancers had gone, required the constant operation of two large pumps for seven days. An idea of the immense quantity of wine stored in the tank may be obtained when it is remembered

that it would fill 250 cars, or would require 25 trains of 10 cars each to haul it. There are 50 other great wine vats at the winery, each of which is 55 feet in circumference and 20 feet high.

ENGLISH IMPROVEMENT IN LIFE BOATS.

When a life boat is being hastily lowered from a ship it is often dashed to pieces against the vessel because the sailors are unable to disengage the lowering tackle quickly enough. To prevent accidents of this kind an English sailor has invented the device shown in the illustration. Handles are placed in the life boat, any one of which

Life Boat Release

on being pulled will release the tackle provided the boat is in the water.

Commander Ingleman, of the Swedish navy, says: I observed during the short interval of 1 minute 10 seconds the boat which was previously lashed in its chocks, with turned-in davits, was lowered into the water and disengaged from the lower blocks.

CHAIN SUSPENSION BRIDGE.

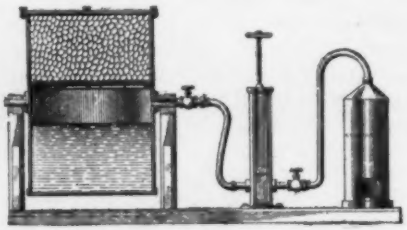
A chain suspension bridge, 1,000 ft. long, supported on four towers, was a remarkable feat of engineering in 1826 when it was built across the Merrimac river at Newburyport, Mass. Each span was 200 ft. long, and a bascule draw was arranged at one end for the passage of vessels. The chains each had a breaking strength of 20 tons. The

Chain Suspension Bridge at Newburyport, Massachusetts, Built in 1827

bridge cost $70,000, and was taken down 13 years later, when purchased by a railroad company which built a new bridge using the old piers. In the Railroad Gazette will be found full details.

EGG PRESERVING MACHINE.

An unusual method of preserving eggs has been patented by a man in Oregon. The cut will help explain how it is done. The eggs



Egg Preserving Machine

are placed in the upper half of an air-tight barrel, from which the air is then exhausted. The vacuum thus formed is supposed to draw through the shells any air in the body of the egg. The barrel is then inverted and a liquid preparation pours down, filling the pores of the shell. The eggs are dried in the open air and then given a moisture-proof coating of shellac and alcohol.

ELECTRC CANAL HAULAGE.

The "Zeitschrift fur Elektrotechnik," of Berlin says: "The system of electric haulage on canals in general use consists in running an automotor on the path along the canal. This requires a very good path and is expensive in the cost of road construction and maintenance. In addition there are unavoidable vibrations of the engine. With two rails the roadbed construction is less expensive, but the adhesion is not sufficient for dragging heavy boats. Still greater economy in roadbed construction is effected if a single rail be used, but there still remains the adhesion difficulty. An idea of Fabre seems to overcome the difficulty by employing two axle pairs, inclined against one another, instead of the usual two wheel axles, each with two vertical axes. A wheel is mounted on each axle, and each pair of two wheels grips the single rail. The engine is supported by one broad lateral wheel which runs on the road, the object aimed at being to increase the adhesion and stability of the engine.

The Age of the Turbine Has Come

New Motive Force is Rapidly Supplanting the Reciprocating Engine for Marine Transportation

That erstwhile great machine, commonly known as the steam engine, which has probably done more than any device of man's invention in the advancement of commerce, is fastly outliving its usefulness for marine propulsion and must soon surrender to a newer, smaller yet more powerful motivity. The turbine will soon be the newly crowned king of marine motive force. Its province is rapidly broadening to include many fields formerly occupied by the old style steam engine.

Soon a turbine equipped steamer is to cross the Atlantic; in England they are being planned for steamers for cross-channel service; the Union Steamship company of New Zealand has ordered a large turbine-propelled steamer to ply between Australia and New Zealand; the Allan line will place a 12,000-ton turbine steamer in service between Liverpool and Canada; the Cunard company is now considering the advisability of equipping their two leviathans with turbine engines, with the prospects that the reciprocating engines on both will be abandoned. A turbine passenger steamer will go into service on Lake Ontario next summer.

The manufacturer who does not foresee the coming revolution in motive force will suffer for his stupidity and awaken from his stupor to find a new era of things about him while he still saunters in the past. The world's leading mechanical authorities are beginning to realize this fact and from across the seas we are hearing words of admonition against dangers of not heeding the warning. The London Mechanical Review, which voices the opinion of Europe's leading journals, says: Fresh evidence is being supplied almost daily that not only for small craft but for large sea-going vessels where high speed and comfort are desirable, the turbine is becoming the favorite motor. There are many good reasons for the preference. The turbine propels at higher speed with greater economy of fuel. In other words, the compound turbine imparts more power to the screw propeller from a given quantity of steam than has ever been obtained from the older form of engine. And while it is not more costly to install, even now, it is considerably lighter, occupies much less engine room space, and, therefore, allows more room for cargo and passengers. It tends to greater stability in the vessel owing to its low center of gravity, and this means that in warships the propelling machinery will be better protected from the irruption of shot or shell, for it can easily be well below the water line. Perhaps the most noticeable point in favor of the turbine is the extreme simplicity of its construction. The only wearing parts are the bearings. This means easy lubrication and less trouble in repairs. Then again, the knocking and vibration which are inseparable from reciprocating engines in which the momentum of moving parts is constantly reversed, must be almost entirely absent in the rotary engine, the balance of which is so perfect. There can be no tremor or shock except what little may result occasionally from the action of the screw propeller in a turbulent sea.

BOY BUILDS MOTOR CAR.

Starting with a soap box for material, a San Francisco boy of 16 has built an "automobile" which will travel nearly 10 miles

Soap Box Auto, San Francisco

an hour. Six months were spent in the building. He made the patterns himself and had the castings made in a foundry, then

finished them up. A friend forged the crank shaft. The Motor Age says:

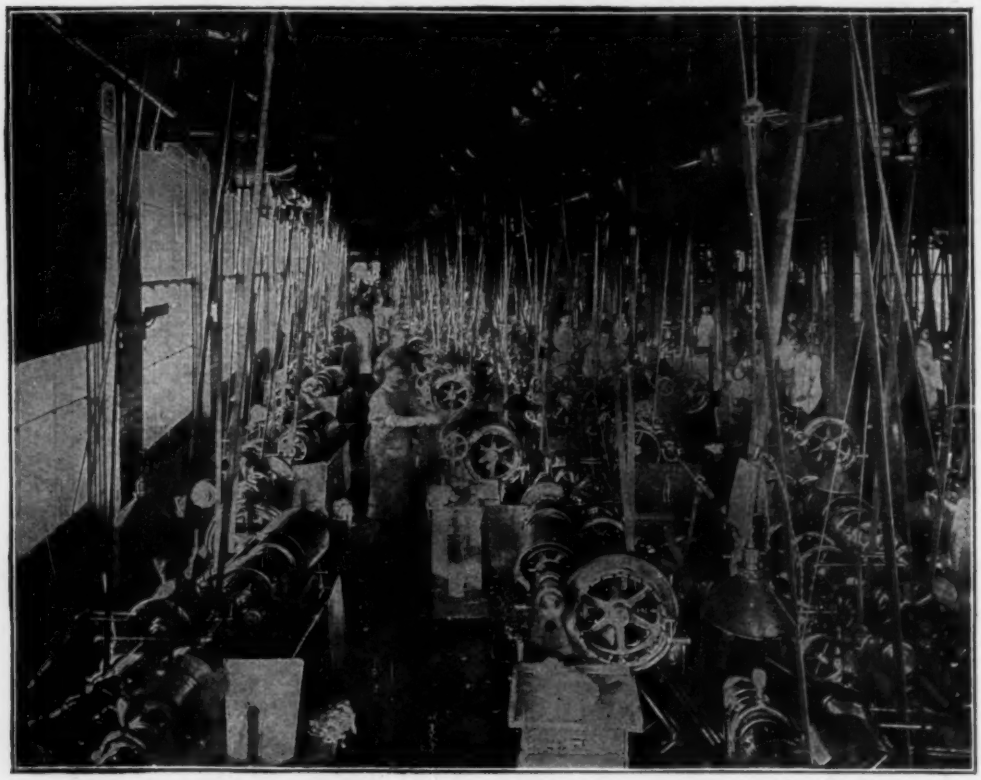
"The frame of the vehicle is made from two pieces of oak attached to two axles. The rear axle is solid with two wheelbarrow wheels and babbitt bearings. The front axle turns on a king bolt, buggy style. The steering gear is an ordinary pair of bicycle handle bars. The seat is 2 feet high, necessitating steering by the feet on the handle bars. From the seat the clutch and air valve are operated. The engine is vertical under the seat, and the gasoline tank serves as surface carbureter. A rubber hose connects the tank with the motor. Air enters the tank through a hole, and in passing over the fuel picks up a charge."

The first steam warship ever constructed by any nation was built and launched at the Brooklyn Navy Yard. It was the frigate Fulton, a 30-gun vessel of 2,000 tons, built in 1815.

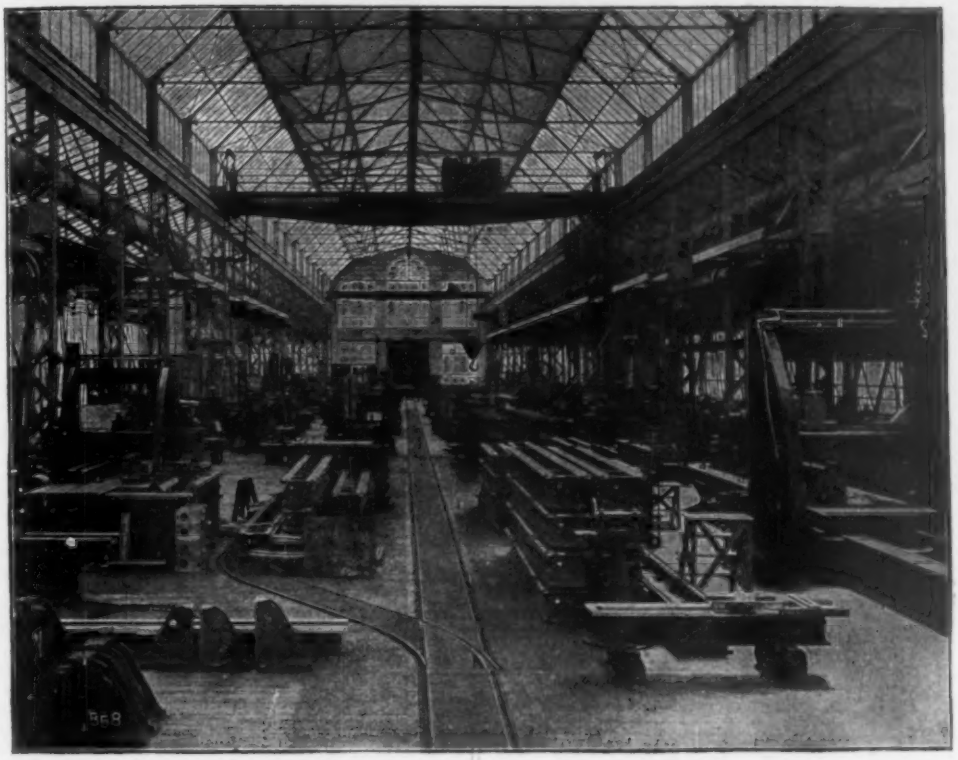
MACHINE SHOP WITHOUT SHAFTS OR BELTS.

Electric Motors on Each Machine Effect Great Saving

Instead of miles of expensive belts filling the air with dust, and tons of costly shafting and pulleys, the modern machine shop has a small electric motor to drive each machine. Electric current to supply these motors may be bought from some power company, or made in the works by a large generator driven by a steam engine. In place of the great mass of overhead shafting, which shuts out light and requires extra heavy timber construction to sustain it, a few wires, scarcely noticeable, transmit the power with only a small fraction of the loss. In every belt driven shop may be seen scores of belts moving rapidly, being worn out and using up power, but doing nothing because the machine to which they



The Old Way.
An example of a great investment in shafts, pulleys and belts, causing a loss of power in transmission amounting to over sixty per cent.



The New Way.

Electrically Driven. No belts, shafting or pulleys. Allows a clear headway for crane service; a more convenient and economical arrangement of machines, and better lighting.

belong is not in use. With the electric motor, no power is used unless there is use for the machine it drives. The illustrations furnish a striking comparison of the belt-driven and motor-driven shop.

HUGE CONDUITS FOR WATER POWER.

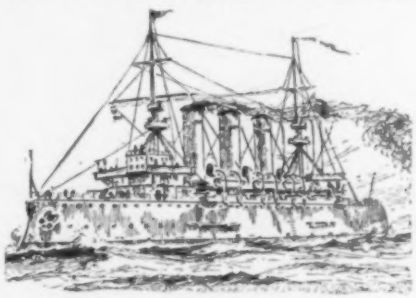
Twelve feet in diameter or large enough for a horse and cart to drive through are the enormous conduits being built in France in the work of harnessing the streams for water power. So valuable has become this water power in France that there it has been dubbed "White Coal." One-half million horsepower has already been obtained from the streams of France, and more plants are being built every day.

A WATER PIPE USED IN FRANCE.

In utilizing the water power it is necessary to construct conduits large enough and strong enough to conduct water forced through at a very high pressure without bursting the conduit. They are made of steel or cement strengthened with iron bands, and are furnished with safety valves in case of emergencies.

TURKEY HAS NEW CRUISER.

Any addition to the Turkish navy is a great event—for the Turks. "Abdul Hamid"



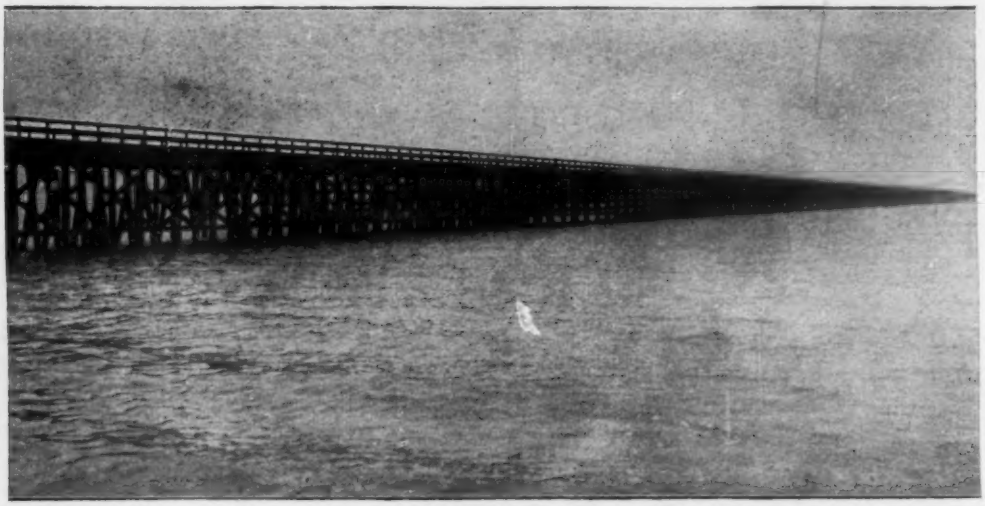
Cruiser Abdul Hamid

is the latest, a small cruiser 340 feet long, 47 feet 6 inches beam.

Golden Spike Completes the Cutoff

Natural Oppositions Seemingly Defied in Building a Railroad Across Great Salt Lake

FACTS ABOUT THE OGDEN-LUCIN "CUT-OFF."	
Original road	146.68 miles
New road	102.91 miles
New road saves	43.77 miles
New road saves 3,919 degrees curvature.	
New road saves 1,515 feet vertical grade.	
Annual saving in operating expenses	$500,000
Permanent trestle built in Great Salt Lake	11.10 miles
Temporary trestle built	11.84 miles
Distance between the east shore and Promontory Point	8.03 miles
Distance between the west shore and Promontory Point	19.45 miles
The permanent trestle is nearly all in water from 30 to 34 feet deep at the present level of the lake.	



Ogden-Lucin Cutoff Through Great Salt Lake—Permanent Trestle

It seems that the science of civil engineering has advanced so greatly that nature can no longer successfully oppose obstacles to the construction of railroads. When Collis P. Huntington first thought of going through mysterious Salt Lake instead of around its northern end, he was regarded as a dreamer. When Edward H. Harriman actually undertook to do the thing at an expense of nearly $5,000,000 he was thought to be courting ruin. The western press ironically referred to Mr. Harriman's "great sink hole," into which he was said to be pouring millions that would never bear fruit. But now that the Ogden-Lucin cutoff is an accomplished fact, its advisors and R. McCullough, third vice-president of the constructors are being hailed as men of wondrous genius and foresight. Railroad men laud the courage displayed by Mr. Harriman in risking the undertaking and J. Kruttschnitt, William Hood, Horace C. Burt and J. B. Berry, officials of the Union and Southern Pacific are praised for advising its undertaking.

The completion of the Ogden-Lucin cutoff was memoralized by the driving of a spike of solid gold by E. H. Harriman. H. Northwestern railway says the opening of the Ogden-Lucin cutoff was more historical than the union of the east and the west when the golden spike was driven into the Southern Pacific track on Promontory Point, May 9, 1869. He said: "It represents the limit of development in transportation methods contrasted with the journey of old Jim Bridger when he discovered the great Salt Lake and the Bear river in 1824. Since then the expenditure of many millions has reduced the time to three days, and finally the elimination of the summit of Sherman Pass by the Aspen tunnel, the conquering of Salt Lake, the reduction of grades and the elimination of curves, and the double tracking of the Northwestern, all at an ex-

Building the Cutoff—Men Working on Rafts, "Where Everything Floats."

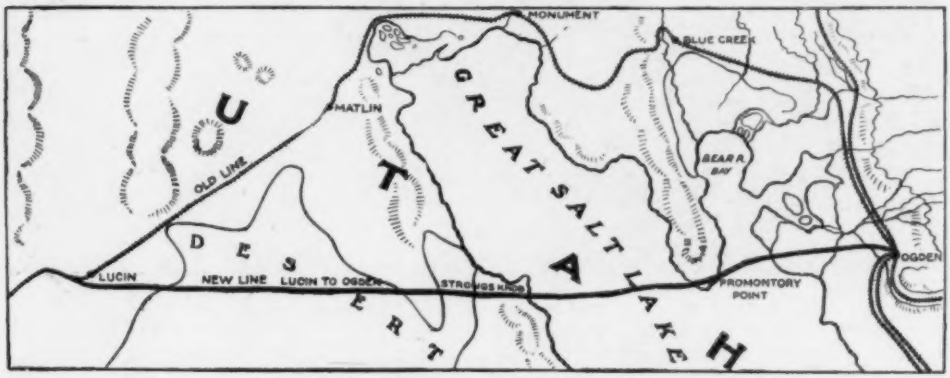
pense of more than $60,000,000, have made possible the further reduction to two and one-half days or two days from the Missouri river as against sixty days by the overland stage of fifty-three years ago.'

The Ogden-Lucin cutoff runs 72 miles on land and over 30 miles on the trestle-work and fill-ins over the waters of the Great Salt Lake. The use of the cutoff will throw out of transcontinental traffic the old line from Ogden to Lucin, Nev., around the north end of Great Salt Lake. This stretch of

Permanent Trestle and Roadbed Over Great Salt Lake

track, nearly 147 miles long, is one of the most difficult and expensive of the Harriman system. Its maximum grade over the long promontory hill is 104 feet to the mile and helper engines are required to handle trains. The elimination of this trackage from overland traffic will thus mean a saving of more than $1,500 a day, in the actual operating and also a saving of two hours in running time.

The cutoff runs from Ogden west for fifteen miles over level country before reaching the lake shore, then crosses the east arm of the lake, a width of nine miles, to Promontory point; then nineteen miles across the west arm of the lake; thence across the Great Salt Lake desert to Lucin, Nev. Across the east arm of the lake will be an almost continuous fill-in supporting the trestle. Near the middle of this will be a gap of 600 feet of open trestlework, left for the waters of the Bear river, which flows into this arm of the lake.



Map of the New and Old Lines Showing the Distance Saved

Across Promontory point runs five miles of solid roadbed, and here difficult work was encountered, a cutoff of 300 feet in length in sand and rock of abrupt bluff being necessary. On this point, one of the most picturesque around the inland sea, a station will be maintained, and surveys have been made for a mammoth summer resort. Across the west arm of the lake is a stretch of eleven miles of trestlework, with a fillin approach at each end.

In accomplishing the work of spanning the lake, one great difficulty was encountered across the east arm, in the "sinks" or settling of the fillins and trestlework. This was caused by the salt from the flow of Bear river having collected for centuries over the bottom of the lake and formed an insecure foundation for a depth of nearly a hundred feet. It took thousands of tons of rock and piles without number to reach bottom proper, but this was finally accomplished, and the gradual spreading out and packing of the fill has resulted in a firm roadbed.

RUBBER AND ITS SUBSTITUTES.

Over 100 million dollars worth of manufactures from India rubber are now turned out from the factories of the United States every year, and about half this total is in the form of boots and shoes. The industry of importing and reclaiming India rubber for re-use in manufacturing is, comparatively, a new one, and while it utilizes large quantities of worn-out rubber, boots and shoes and other articles of this character from the scrap heaps of the United States, it has extended to other parts of the world only in recent years.

In 1893 the total importation of old and scrap India rubber fit for re-manufacture was less than a million pounds. In 1896 it was over 3 millions; in 1898, more than 9 millions; in 1900, 19 millions; in 1902, 22 millions, and in 1903, 24,659,394 pounds, valued at $1,516,137.

Gutta-joolatong is another comparatively new material which may be utilized in conjunction with India rubber. It is a product of the East Indies, chiefly the Island of Borneo, located not far from the Philippines. In the form in which it is imported it is of a whitish color, looking something like marshmallow candy, smelling strongly of petroleum and oxidizing on exposure to the air, becoming hard. It is not a substitute for gutta percha or India rubber, but is used chiefly as a filler in manufactures of India-rubber gum and gutta percha.

Prism for Measuring the Actual Dip of the Horizon

If you should ask the navigating officer of a great ocean liner or battleship when at sea what was the most important thing to him, next to his compass, he would answer, "To know where we are."

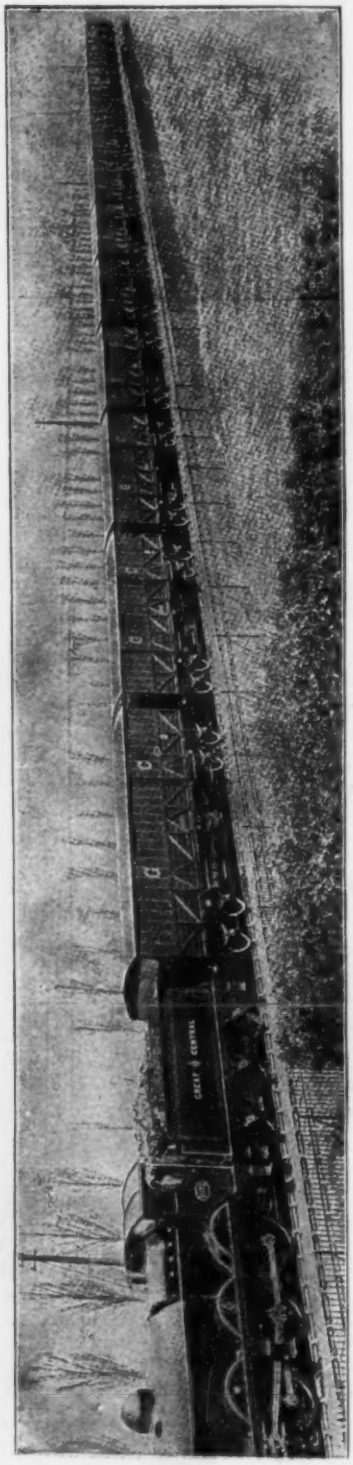
To determine this fact every vessel is equipped with charts showing all the harbor entrances, signal lights, sunken rocks, reefs, islands, etc. When once out of sight of land calculations can no longer be made from lights and shore land marks, and an instrument, the sextant, is employed.

In order to secure reliable data, however, a clear atmosphere is necessary. Even then mistakes are frequent, and the navigator suddenly finds himself many miles out of the supposed course. When the cable steamer Farraday was laying a cable from Nova Scotia to the Azores three years ago, nine expert navigators were busy taking sights from earliest dawn to dark. One bright day all observations were found to be wrong, and after several hours' corrections were secured it was found the ship had been sailing three miles out of the intended course. The mistake was caused by a change in the atmosphere which had raised the apparent horizon above normal.

Measuring the Actual Dip of the Horizon

One of the navigators on this cruise was Commander Blish of the U. S. Navy, who has been working since that time to devise an instrument which should be absolutely correct. He believes he has succeeded by the use of a prism which is attached to the sextant.

Fish Train on the Great Central Railway of England



Nineteen Cars Each Carrying Fifteen Tons of Fish

FISH TRAINS OF ENGLAND.

Like American Cattle Trains, They Make Fast Time and are Composed of Special Cars

Fish trains are becoming as common in England as are cattle trains in America. The innovation was started by the Great Central Railway, which has an enormous volume of fish traffic from the coast. A typical fish train on this line is shown in the illustration. Special cars are used exclusively for this kind of traffic. The cars are handled in complete trains by ten-wheel engines on a fast schedule. The train illustrated is made up of 19 cars carrying 15 tons each, each car weighing 19 tons when not loaded.

The Railway Review says: "The floors of the cars are cemented, and the loads arranged to make the run from Grimsby Docks to Marylebone, a distance of 223 miles, to be made in about seven hours, including the time occupied in distributing portions of the load along the road."

ANOTHER NORTH CAROLINA MILL.

North Carolina seems to be the home of the odd and antiquated water mill. One of them was shown in a recent issue of Popular Mechanics. Here is another—a grist mill, which was imitated by Illinois in pioneer days. The mill was constructed near a spring that flowed over a bluff. A heavy post was set up with a natural fork at its top. Across this fork a beam extended, on one end of which a box was constructed, and from the other end of which a boulder was suspended over a mortar hollowed out from the stump of a tree. As the box filled with water it descended and raised the boulder-pestle. When the box descended the water ran out and the empty or partially empty box, overbalanced by the boulder, rose to be again filled and repeat the teetering operation. It was automatic and all the settler had to do was put his corn in the mortar, swing the box around into range of the spring by attaching the boulder and go about his business. He could put the corn in at night and find it converted into meal by morning, for, as the mill required no attendance, it worked just as well at night as any other time.

Flash New Year's Greetings Round the Globe

Naval Observatory Sends Telegraphic Time Signals and Receives Them on the Same Chronograph

The United States Naval observatory sent telegraphic time signals throughout the world to mark the beginning of the new year. The signals were sent last year for each of the four great standard time belts of the United States, but this year the observatory secured not only a wide distribution of the signals throughout North and South America, by the co-operation of the telegraph and cable companies, but also sent two of the four series of signals around the world and back to the naval observatory. The signals began at 11:55 p. m. and ended at midnight eastern time. The same series were sent out an hour later, ending at midnight central time. Again an hour later, ending at midnight mountain time, and again an hour later ending at midnight Pacific coast time. On the world circuit the signals went by land lines to Cape Causo, Nova Scotia; thence by cable to the Azores, Lisbon, Gibraltar, Malta, Alexandria and Port Said; by land to Suez; by cable to Aden and Bombay; by land to Madras; by cable to Penang, Singapore, Saigon, Hongkong, Manila, Guam, Midway, Honolulu and San Francisco and by land back to Washington. Both the outgoing and ingoing signals were received on the same chronograph at the naval observatory and thus a permanent graphic record of both were preserved on a single sheet of paper.

Besides demonstrating the possibilities of practical astronomy and telegraphy working together, through international co-operation, benefits will result from the general attention the signals directed to the advantages of using accurate standard time throughout the world. The messages also carried a New Year's greeting to the world.

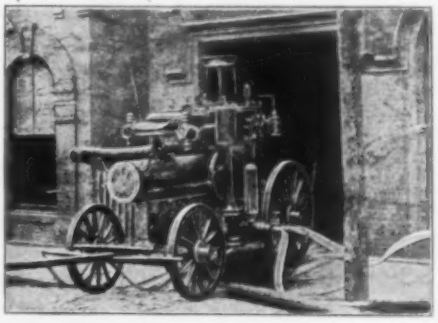
FIRE ENGINE OPERATED BY COMPRESSED AIR.

A steam fire engine was operated successfully with compressed air instead of steam at Norwich, Conn. Chief Stanton has been experimenting for some time and it is possible the entire system of operating fire engines, at least in the business districts o large cities, may be changed as a result.

For the test pipes were run from a large air compressing plant to Central Wharf, where the steamer was stationed. An air pipe 1¼-inch diameter and 500 feet long conducted the air to the steamer where it was connected to the boiler. No fire, of course, was necessary and the boiler was filled with air at a pressure of 90 pounds instead of steam. When the pumps were started the machine was taking water through a supply hose 28 feet long and playing three 1⅛-inch streams 150 feet through three lines of hose. The test lasted an hour and a half. Frost formed on the cylinders, and at a distance of 100 feet the exhaust from the stack looked as much like smoke as if there were a fire in the machine.

The advantages of the compressed air are several. A great saving in weight resulting from doing away entirely with the boiler so that one horse could haul the machine. In some cities the water used for fire purposes is not of the best, and causes the boilers to foam. The compressed air fire engine could be built for one-third the cost of a steamer of equal capacity.

The plan proposed is to have a central compressing plant with pipes leading in all directions and places at frequent intervals where the fire engine could connect to the



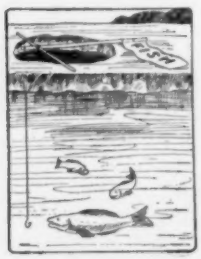
Compressed Air Fire Engine

air system. There would be no time lost in getting up steam, and no fuel to carry on the engine, while the machine itself would weigh much less than an ordinary one-horse hose cart when loaded. The Firemen's Herald says the proposed plan could not do away with the steam fire engine entirely, but might be used to very great advantage in many places.

MECHANICS FOR YOUNG AMERICA

Devices of Winter Sports--How to Make and Use Them

Fishing in the south is confined to the warm season, but in the north the red-cheeked boy digs a hole in the ice and while he amuses and invigorates himself at skating, the fish underneath the icy sheet fasten themselves to the hook he has let down through a hole. The northern boy used to sit over the hole in the ice and wait for the fish to bite, but that became too slow and detracted too much from his pleasure at skating. So his inventive genius set itself to work and the "tip up" and "signal" shown in the illustration was the result. When the fish is not biting the flag lies flat on the ice, but as soon as a fish has swallowed the hook the flag pole stands straight up wafting its bright colored flag to the breezes and all the boys on the skating pond read the word "fish." The fish is drawn up, the hook rebaited and the youthful fisherman resumes his pleasures on the ice. Often a score or more of these "tip ups" are planted about the edges of the ice pond, each boy bringing his fishing tackle with his skates and thus finding a double source of amusement. Maybe one boy will thus have a half dozen different lines in the water at once, it being easy to watch them all together.



"Tip-Up" Pole

"Tip-Up" Fish Caught

The device by which the fish is made to give its own signal when caught is exceedingly simple and any boy can make it. Procure a light rod about two feet in length and to one end fasten a small flag, made of any bright colored cloth. Bind the rod at right angles to another stick which is placed across the hole, so that a short piece of the flag-rod projects over the cross stick. To this short end fasten the fishing line. Be sure and use strong string in binding the two rods together, and also take care that the cross stick is long enough to permit several inches of each end to rest on the ice. After fastening the line to the short end of the rod, bait the hook with a live minnow or other suitable bait and let it down through the hole. When the fish is hooked the flag will instantly raise and wave about strenuously until the fish is taken from the water.

"JUMPING JACK" FISHERMAN.

If the small boy has a "jumping-jack" left over from Christmas he may make this do his fishing for him and serve as well as the "tip-up," or he can easily make the jumping-jack himself independent of Santa Claus. The string which is pulled to make the joints move is tied securely to the fishing line; the hook is baited and lowered into the water through a hole in the ice. The "jumping-jack" waves his legs and arms frantically to notify the boys when the fish is biting. The "jumping-jack" is also used for fishing in summer time by placing it on a float which is cast into the water.

"Jumping Jack" Fisherman

WINTER VELOCIPEDE.

Bicycles may be converted into novel sleighs by simply overhauling. The usual bicycle frame and pedals are used, and gearing transmits to contact wheels, in which are sharp spikes for catching in the snow or ice. Instead of moving on wheels the machine is carried on runners.

THE RUNNING SLEIGH.

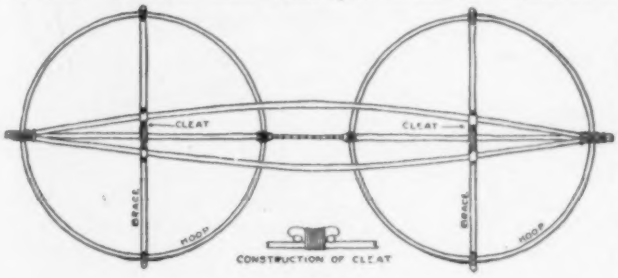
Another winter sport, very popular in Sweden last winter, and that has already reached America, is the "running sleigh," shown in the illustration. A light sleigh is equipped with long double runners and is propelled by foot power. The person using the sleigh stands with one foot upon a rest attached to one of the braces connecting the runners and propels the sleigh by pushing backward with the other foot. To

steady the body an upright support is attached to the runners. The contrivance can be used upon hard frozen ground, thin ice and snow-covered surfaces, and under favorable conditions moves with remarkable speed. The "running sleigh" has a decided advantage over skis, because the two foot supports are braced so that they cannot come apart. Any boy can make the sleigh with a little pains.

THE WINGED SKATER.

With the actual speed of the wind a skater may be hurled along the ice if he is aided by sails. He has been known to travel at the rate of 100 miles an hour, and the sport while affording the limit of excitement, is not attended with danger. The sails are easily made, as the illustrations and description will show.

Secure two large thin hoops about four feet in diameter. They may be obtained from an old hogshead or by bending thin strips. For each hoop select a piece of strong cane about three-fourths of an inch in diameter to constitute the fore and main masts or cross-yards. Extend these across the center of the hoop and fasten each end firmly to the hoop's sides. For the middle of each cross-spar make a



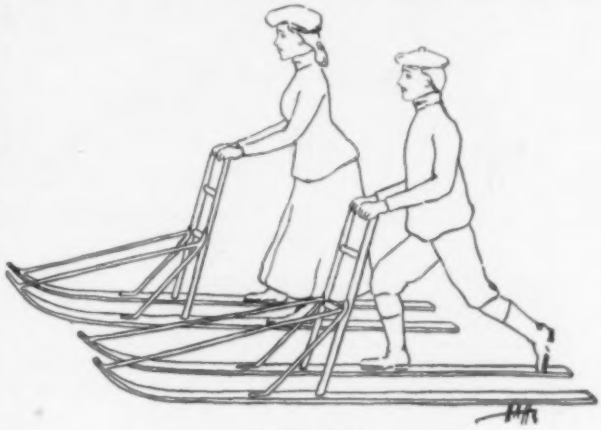
Skater's Sails

cleat and lash it on firmly.

The main spar should also be made of two pieces of strong cane, each about 9½ feet long. Bind them together at each end so that the large end of one is fastened to the small end of the other.

Next comes the attaching of the sails to the separate masts. The sails should be made of strong sheeting or thin canvas. Tack the cloth to the hoop on the inner side after the cloth has been wrapped around the hoop two or three times.

Now the main spar should be attached by springing it apart and slipping the cleats of the cross-spar between the two pieces. Bind the inner sides of the hoops tightly together by means of a very strong double cord, as shown in the figure. Then your sail is ready for the ice pond. See that your skates are securely fastened, raise your sail and you will skim along the ice as lightly as a bird on the wing. With a little practice you will learn to tack and guide yourself as desired.



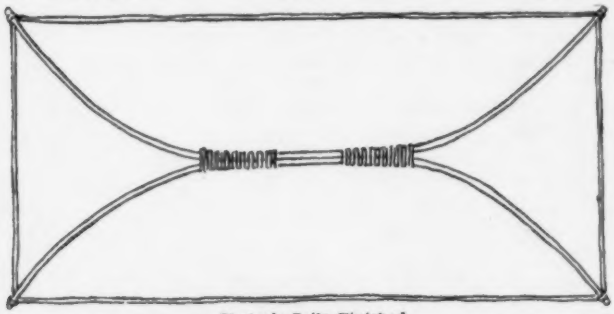
Running Sleigh

If the hoops cannot be easily obtained the sails may be made equally effective by using the main spar and fore and main masts as herein described, making the sails square shaped instead of round and leaving off the hoops. In this case the sails should be securely bound with strong tape. Attach a corner to each end of the cross-spar, and a corner to the outer end of the main spar. The remaining corner of each then appears opposite to each other, and should be fastened together by strong cord in the same manner as the hoops. In this case the sails may be left off until after the frame

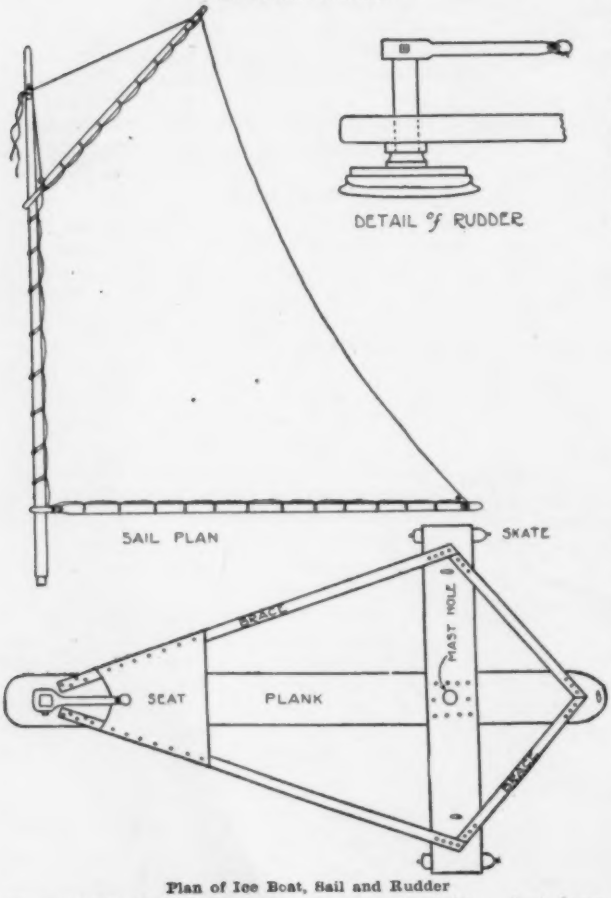
The Bicycle Sleigh

is entirely put together and then fastened on to the spars by buttons.

A more simple sail may be made according to the plans illustrated in the lower drawing. It is made by binding together in the center the halves of two strong hogshead hoops, or two bent poles are better.



Skater's Sails Finished



Plan of Ice Boat, Sail and Rudder

If possible the sail should be about eight feet long and four feet wide. Fasten on the sail at the four corners. The rig will convey two persons and is more easily constructed than any other.

ICE BOATING.

But the sport that is greatest of all, the one that used to be part of the life of every northern boy, and which is being revived in popularity after years of stagnation, is ice boating. With the aid of old skates, pieces of board and an old sheet or a small bit of canvas, any boy possessed of ordinary mechanical genius may make an ice boat. The frame of the boat should be made something in the form of a kite. The center-board should be four or five feet long, six inches wide and two inches thick. The cross board may be of a piece of 1 by 6 inch plank three feet long. Fasten these with braces of small stout strip, as shown in the drawing, and screw the cross piece securely to the center-board. Bore a hole in the center of the intersection for the mast pole. The seat may be made of a piece of strong cloth or leather. Three skates are fastened on to either

Boy's Ice Boat

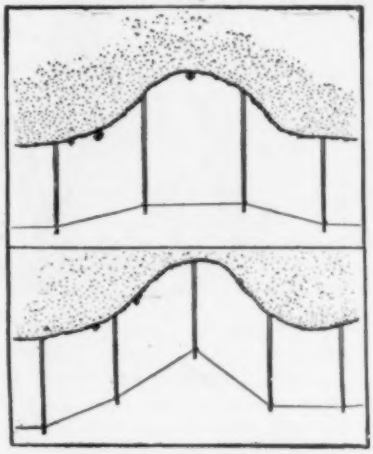
side of the cross-board and one to the rear end of the center-board, the latter of which is to operate as a rudder. In attaching the skates first make a couple of runner blocks, each six inches long and three inches wide. Bore holes in them for the straps of the skates to pass through and fastea them securely. Nail the runner blocks firmly to the cross board about 1½ inches from each end.

In making the rudder hew down a piece of scantling one foot long until is assumes the shape of a club with a flat base. Nail a strip of wood firmly to this base, and to the strip fasten the skate. Run the top of the club through a hole bored in the stern of the center-

board. Then make the helm by boring a hole in one end of a strip of soft board about one foot long, and through this hole pass the club or rudder-pole and fasten it so it may be shifted when desired. Make the sail out of an old sheet, if it be strong enough, piece of canvas, or any such substance and attach it to the mast and sprit as shown in the illustration, and guide it by a stout string attached to the lower outer corner. As an ice boat will travel faster than the wind, some care and considerable skill is necessary. Unless you are accustomed to managing a sail boat do not select a place in which to learn where there are air holes or open water. To stop the boat throw the head around into the wind, same as you would with a sail boat. If the wind is strong the occupants of the boat should lie flat on their stomachs.

GRADING A POLE LINE.

Grading a pole line is a term used by telegraph and telephone linemen. It is very much like grading a railroad—trying to secure as near a level as possible. The Telephone Journal explains the process with an illustration. The advantage of the level line is in equalizing the strain on the poles and insulators.



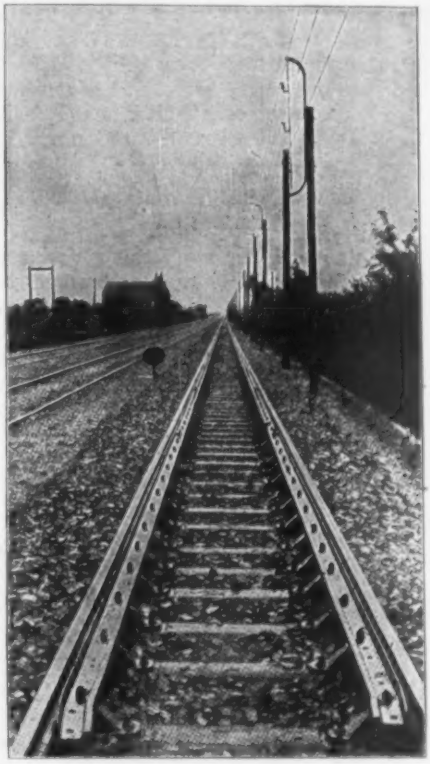
Grading a Pole Line

In the first illustration the tendency is to pull over the poles on the side of the hill, and to pull up the one at the bottom. The second cut shows how the line should be built.

Insurance against appendicitis is the latest English insurance fad. A policy costs $1.25 a year, and insures surgical treatment, not to exceed $500.

HIGHEST SPEED RAILWAY TRACK.

The remarkable world-breaking record of 130 miles an hour on the Berlin-Zossen line, described in the November issue of this magazine, was made upon the railway track



World's Record Track

shown in the accompanying illustration. In order to lessen the danger of the experiment a guard rail was laid next each main rail, on the same plan American roads employ on bridges. Instead of standing the rail in an upright position it was placed on its side with the base of the rail next the main rail. The Electrical Review says: "These guard rails were bolted to cast iron chairs, which in turn were bolted to the ties."

There are three waters in the state of Indiana which actually impart magnetic powers to needles, knife blades, etc. Any considerable quantity of one of these waters will deflect the needle in a compass.

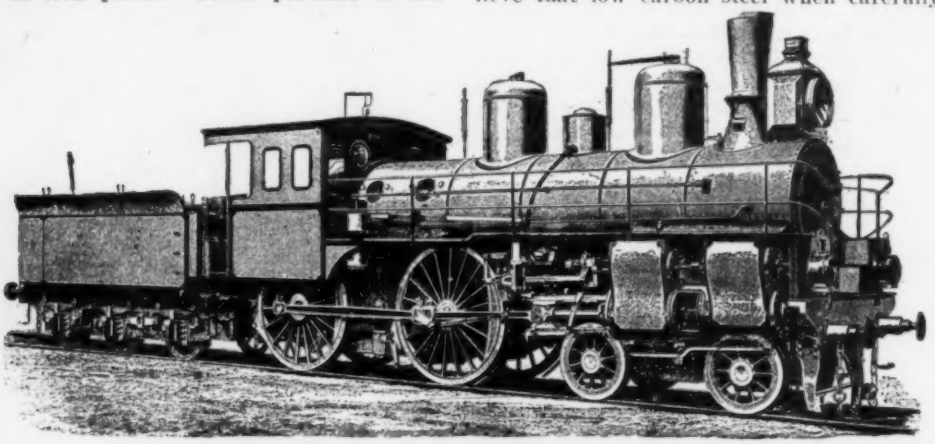
Popular Mechanics is written so you can understand it.

FROST ON SHOW WINDOWS.

As an excellent remedy against the freezing of show windows, the Pharmaceutische Zeitung, a German publication, recommends the application of a mixture consisting of 55 grams of glycerin dissolved in 1 liter of 62 per cent alcohol, containing, to improve the odor, some oil of amber. As soon as the mixture clarifies, it is rubbed over the inner surface of the glass. This treatment it is claimed, not only prevents the formation of frost, but also stops sweating.

RUSSIAN PASSENGER LOCOMOTIVE.

The standard express locomotive on the Russian Empire Railways are tandem-compounds, and make as high as 70 miles per hour on fairly level track. The illustration shows the drivers set well back and two high steam domes. The boiler plates are ⅝-in. iron plates. Steam pressure of 191 pounds is maintained. The cylinders are 14⅜ and 21½-in. diameter by 24-in. stroke. Absence of a bell, the top of smoke stack and the sawed-off appearance of the front end, peculiar to continental service, will all be noticed in the cut.



Tandem Compound Russian Express Locomotive

The telechirograph is a German invention by which one's handwriting may be transmitted by telephone wires, without the services of an expert receiver.

STEEL TUBES FOR LOCOMOTIVES.

Iron tubes are used in the locomotive boilers of almost every railroad in the United States. On the few roads here which have used the steel tubes the results have been so satisfactory that their general adoption is not unlikely. In France and some continental countries the steel tubes have been used for upwards of 10 years. Where only impure waters are obtainable the steel tubes are specially desirable. Greater care is necessary in their manufacture owing to the rapidity with which they cool when being welded. The best practice now is to reheat the tubes after welding and allow them to cool in the retort in which they are reheated. It has been claimed that steel pits more rapidly in boilers than iron, but this is by no means certain.

Professor Henry M. Howe in a paper on the relative corrosion of wrought iron and steel, said: "We have strong reason to believe that low carbon steel when carefully made resists corrosion in fresh water as well as wrought iron, and in acidulated water, better than wrought iron."

The Railway Age says: "Mechanically the steel tube is decidedly superior to the iron one. It is much stiffer and is better suited to the great lengths required in modern boilers. The bursting strength of steel tubes is much greater than that of iron tubes, and the tensile strength 25 to 30 per cent greater."

Out of the great overflowing abundance of printed matter about mechanics is gleaned the helpful, the clean, the instructive, all the rest is discarded; the essence of the gleanings is gathered and concreted, and the result is called Popular Mechanics. Its success attests its merits. Some people say Popular Mechanics is the best magazine published.

SHOP NOTES

PORTABLE ELECTRIC "SCOTCH" DRILL.

A handy machine recently patented is a Scotch drill operated by electricity. It can be used in any shop having incandescent electric lights by connecting to the nearest socket. It will drill up to ⅞-inch diameter

Electrically-driven "Scotch" Drill.

and has a feed of 7 inches, controlled by the hand wheel. It is mounted on a pedestal which admits of movement in any direction. The machine is 30 inches high and weighs less than 100 pounds.

LEATHER BELTS.

A leather belt is more economical in the end than a rubber one. When buying a leather belt it should be tested by doubling it up with the hair side out; if it should crack, reject it as it cannot realize the whole amount of power it should transmit. If it shows a spongy appearance it should be condemned at once, says Dixie, for it must be pliable as well as firm. The grain or hair side should be free from wrinkles and the belt should be of uniform thickness throughout its length. It should be tested for quality by immersing a small strip in strong vinegar. If the leather has been properly tanned and is of good quality, it will remain in vinegar for weeks without alteration, excepting it will grow darker in color. If the leather has not been properly tanned the fiber will swell and the leather will become softened, turning it into a jellified mass.

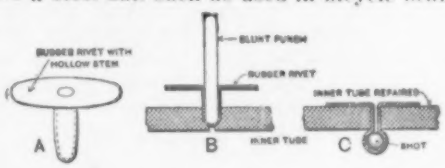
Some people have an idea that a new belt that does not stretch any is the best for transmitting power, but this is a mistake. A belt in this condition is very apt to break when used to transmit variable loads.

HOW TO MAKE STOVE POLISH.

Mix 2 parts of copperas, 1 part of bone black and 1 part of black lead with sufficient water to form a creamy paste. This will produce a very enduring polish on a stove or other iron article. After two applications it will not require polishing again for a long time, as the copperas will produce a jet black enamel and cause the black lead to permanently adhere to the iron.

NEW METHOD OF REPAIRING TIRES.

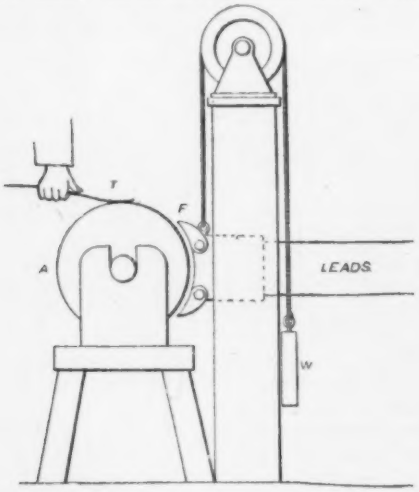
A French firm has announced a new process of repairing punctures in auto tires. Patching with cement has usually been short-lived, and almost sure to leak and deflate the tire at high speed. By the new method, says Machinery, a rubber rivet, A, is used, having a hollow stem. This rivet is pushed through the puncture, using a blunt punch for the operation as shown at B. After the rivet is in position, a shot such as used in shot-guns of about the size known as B or BB, is pushed through the stem until it reaches the bottom where, of course, it enlarges the stem to a considerably larger diameter than it is in the neck where compressed by the walls of the punctured tube. For large punctures it may be necessary to use a steel ball such as used in bicycle bear-



ings. The result is that the rivet cannot become dislocated when in use without tearing off the stem or greatly enlarging the hole. Of course the under side of the rivet head is treated with rubber cement before being placed in position.

INDUCTION TESTS FOR SHORT CIRCUITS.

The drawing illustrates a method of testing armatures for short circuits, reported in the proceedings of the American Railway Mechanical and Electrical Association. The apparatus used in this case consists of an old Baxter motor field, F, suspended between two uprights and balanced with a counterweight, W, so that it may be adjusted to conform to the various heights of different armatures, A. This field is wound with No. 9 wire and supplied with alternating current from a small, belt-driven dynamo. The armature is placed in the magnetic circuit of this field and revolved slowly, and a small telltale piece, T, consisting of a light piece of sheet metal, is held at the top of the armature, as shown. If there are any short circuits they will easily be determined, as the telltale piece will set up a vibration, which can readily be felt by the hand. A device of this kind is one of the greatest money-savers possible to put in an armature repair shop, and it will save many an armature from being needlessly burned out, as the short circuits can be detected in the shop instead of developing after the armature has been placed in service.



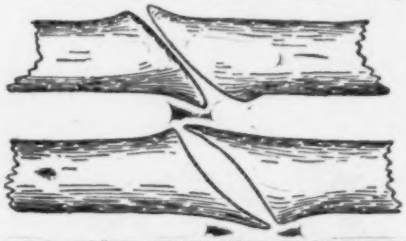
INDUCTION TEST FOR SHORT CIRCUITS.

AUTOMOBILE VS. THE "BUS."

The historic "bus" which for generations has done service between the towns of Kiel, Rheinbishopsheim and Bodersweiler in Baden have been superceded by a modern automobile carrying 20 persons.

RIGHT AND WRONG METHODS OF MAKING A WELD.

Good coal and good materials generally, are among the essentials in the art of welding, writes J. M. Fix in the American Blacksmith. For a good weld have your tuyere iron from four to eight inches under. In other words, have four to eight inches of coal on your tuyere iron depending upon the character of the work you are doing. Coke your coal and beat it down solidly around your fire. Now heat your iron to the welding point—upset and scarf. In order to make the most perfect welds, you must scarf your iron properly. Upset well to allow for wasting away. Have your scarf full in the center, so that the two pieces to be joined will touch in the center first. If there is a hollow in the center, foreign substances are liable to collect in there and cause a very imperfect weld. When they have reached a good, clean, white heat with the scarf down in your fire, take them out and give each one a good jar on the anvil while the scarf is still down, so as to jar off any dirt which may be on them. Reverse or turn over the one you have in your left hand, get them together as quickly as possible and hammer rapidly so as to get them united before the heat gets below the welding point. The cold anvil will reduce the heat below the welding point in a very short space of time. Don't be continually poking at your fire. Let the clinkers gather at the bottom.



THE RIGHT AND WRONG METHODS OF MAKING A WELD.

MACHINE THAT PICKS COTTON.

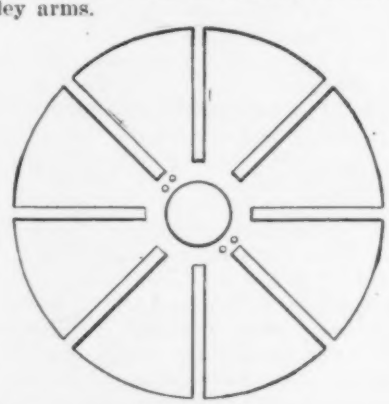
A new cotton-picking machine has been invented. The essential principle of the machine is suction by air, which is produced by fans, the device being pulled across the field by one or more horses. The machine is moved a short distance and then two or three operatives direct the pipe nozzles to the cotton on the eight or ten rows surrounding the machine. The cotton is sucked from the plants as cotton is now sucked from a wagon at a gin.

AIDS INCANDESCENT FILAMENTS.

The Elektrotechnische Rundschau, of Berlin, says: The filament in glow lamps gradually diminishes in diameter in consequence of the slow volatilization of the carbon. A German firm introduces into the glass globe certain chemical compounds with a high boiling point; these, under the influence of the temperature in the lamp bulb, slowly give off vapors containing carbon which is deposited on the filament, thus making up, to a large extent, for the loss caused by the volatilization referred to. Besides it keeps the resistance and the brightness of the lamp more uniform throughout its useful life.

SIMPLE FAN TO COOL DRUM ARMATURES.

A simple home-made fan, easily constructed in any shop, is described by a Canadian writer in the Engineer. It was constructed for use on an armature of the solid-core unventilated type still found in many places. The fan was made of sheet iron. He says: The fan is shown as first made, before the wings are turned. This part I found easy to accomplish by catching the inner ring of the fan in a vise and turning the wings to the proper angle by means of a monkey wrench. When this is done take the dynamo pulley off and slip the fan onto the pulley hub and tie it in position by means of two tie wires run through small holes shown in the inner ring, and around the pulley arm and then twisted, the holes for the tie wires having previously been spaced properly to suit the pulley arms.



Armature Fan

This will be found to blow considerable air onto the back end of the armature, as well as onto the box on the pulley end of the dynamo.

HANDY STOVE PIPE WEDGE.

A pattern for a wedge for fastening a stove pipe into a chimney is given herewith. Sometimes small things wedge

themselves into one's good graces when larger and more complicated ones cost too much or are not to be had just when wanted, says the American Artisan.

Cut a scrap of sheet iron about 4x4 inches and fold or bend, as shown in cut.

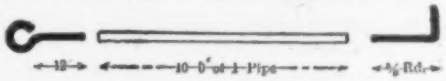
Then pound one end flat and you have a wedge that will hold the pipe securely, for it will spring enough to be very tight in the chimney flue. This wedge can be made on the spot from a scrap cut from the pipe or any bit of old sheet iron.

NEW WELCH TOOL STEEL.

Experiments in making tools of Siemens steel instead of from the crucible, and thereby effecting a great saving in cost, are being conducted in Wales. The new process consists in the use of an alloy, which is a secret. The experiments so far are meeting with success.

HOW TO MAKE A LIGHT POKER.

A long poker, easy to handle because it is light, and which will not quickly heat on account of its being hollow, can easily be made by welding a solid hook at one end of a small wrought iron pipe and a



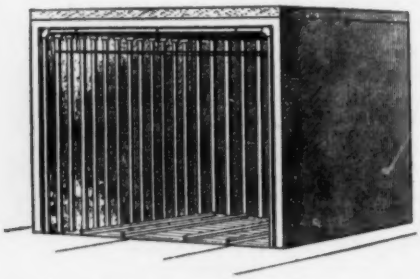
solid handle at the other end. For a poker 12 feet long, 10 feet of 1-inch pipe is about right, and the solid ends should be made from ⅝-inch rod iron. The handle and hook should each be 12 inches in length.

NEW POWERFUL EXPLOSIVE.

The latest in explosives is powdered aluminum mixed with nitrate of "ammonal." It is said to be the safest and surest explosive known. It is not affected by friction or blow. It can only be exploded by an ordinary cap, it is not subject to disintegration, and is not affected by frost or moisture.

HOW TO MAKE A STEAM-HEATED ENAMELING OVEN.

A steam-heated oven for enameling which can be constructed by any mechanic is illustrated in the Metal Wroker. From 80 to 100 pounds steam pressure is required for baking, and the articles to be japanned should remain in such temperature for three hours.



Steam-heated Enameling Oven

The oven shown is much larger than would be required in any repair shop, but its design is such as to permit of easy modification to suit any existing conditions. The oven is heated with live steam, conveyed direct from the main boilers. The walls of the oven are made of two shells of thick sheet iron, so arranged as to form an air space between them. The top is covered with a layer of asbestos about 1 inch thick. The floor is of sheet iron, and in this instance is provided with two tracks, upon which run iron cars carrying the articles to be enameled. This would not be necessary in a bicycle repairing shop, and the bars and hooks could be substituted as in the other ovens. Inside of the sheet iron walls are vertical rows of steam pipes, placed closely together, as indicated. Across the top are other steam pipes. Below the pipes on the ceiling is a sheet iron apron, which serves to catch any dust or dirt that might fall from the overhead pipes. Steam at boiler pressure passes through all of these pipes. It is of the utmost importance in arranging these pipes to provide for their proper drainage—that is, provision should be made for the water condensed from the steam to flow to some point where it could be drawn off.

An extremely uniform temperature can be maintained for any period in this oven. The way in which the heat is applied insures the even heating of every part of the oven. This is essential in an oven of large size, but is of minor value in one of small dimensions designed for the work of a small shop. The degree of heat to be obtained is controlled by the steam pressure available, and higher than this it is, evidently, impossible to go. But any lower temperature desired can be easily and quickly obtained and can be maintained indefinitely.

WAY TO MANAGE A FOUNDRY.

"If a foundry foreman desires to keep his shop up to a high state of efficiency," said an American foundryman recently, "he will, as soon as he receive an order for castings, see that the necessary cores are at once ordered from the core department. Then he will proceed to learn if he has a suitable flask for the casting, and if he has, he will ascertain if any repair work be needed on this, and, if so, he will have this done before the flask is taken to the molder's floor. All repairing of flasks should be done by a flask man instead of by the molder and his helper.

"In order that the molder may use his time to the best advantage, his helper should see that he not only has his facing sand, gaggers, clamps, etc., but he should also look after the many little things which the molder sometimes spends his high-priced time in looking up. Even in specialty shops I have seen molders take a hand in barring up flasks. This they should not have to do as this kind of labor belongs to the flask-maker and the latter will do a better job than the molder every time.

"In a great many foundries the men depend too much upon the foreman for everything. They should remember that he is only human, and has not the time to attend to every little detail. It has always seemed strange, too, that the place where castings are made should receive so little attention from the owners of plants, a majority of whom seem to think that anything can be made to do for this department. Perhaps nearly every practical foreman is familiar with shops where ordinary equipment is so scarce that the molders are spending a great part of their time looking for things of which each should have a plentiful supply. The successful foundry manager of to-day must not only be a practical molder, but also experienced in cupola practice, or he is not fully equipped for the position."

HALF TWISTING A QUARTER TWIST BELT.

I was at one time the proprietor of a planing mill where it was necessary to transmit motion from one line shaft to another where the two were at right angles to each other, says a writer in the American Machinist. The belt was first used in the ordinary way and ran well enough for a while, then it commenced breaking the laces and giving trouble generally. One day the belt was taken down and stretched upon the floor and it was found to be bowed—like an iron barrel hoop when it is cut and straightened out—a result which one can readily see the reason for upon careful observation, as the belt has more tension upon one edge than the other. The belt was then sewn together with a half twist, as shown in the accompanying drawing, with the result that the trouble ceased.

Since that time I have been about the country a good deal and have found several belts running under the same conditions and giving the same trouble and have had the pleasure of suggesting the half-twist remedy, the application of which has always brought the same satisfactory results.

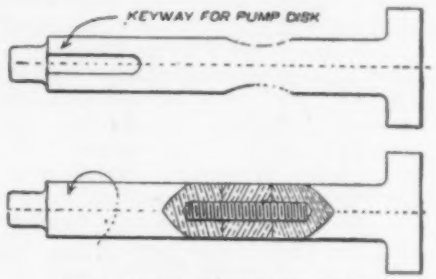
This contribution is offered in the hope that it may meet the eye of someone who is having the same difficulty, whereupon, if he applies the suggested remedy, his troubles will cease.

OPERATING TRANSFER CAR BY CABLE.

The boys were spending too much time pushing the transfer car in a mill, so the superintendent installed a cable system. The following is a condensed description from the Woodworker. A small endless cable was driven from a drum at one end of the mill. One lead of the rope was carried on one side of the track, the return lead on the other, in each case just outside the rails. A grip was placed on each side of the car. To operate the car in either direction the operator has only to close the grip on the side in which the cable is moving in the direction he desires to go.

HOW A PUMP ROD WAS REPAIRED.

Figs. 1 and 2 illustrate the Muntz metal rod belonging to a centrifugal pump, which broke where the packing had worn it to some extent, says Fieldings Magazine, as shown by the dotted lines, Fig. 1. It being necessary to have the pump working as soon as possible, we resorted to the following method of repair. We first drove out the keys, took off the pump disk, faced up the broken ends of each piece of rod in a lathe, drilled up the center of the rod for about 2 inches in each piece, and cut a 1⅛-inch left-handed thread, Whitworth pitch. Next we turned up and drilled a "distance-piece," the length of which was equal to the amount turned off the broken ends, and also cut a thread in the same. Then we turned up a piece of mild steel about 5 inches in length and cut a 1⅛ inch left-handed thread on it, fixed all together as in the sketch, and skimmed up the part that ran in the stuffing-box. If the shaft was driven from the other end in the same direction, of course it would be necessary to cut a right-handed thread. This was much quicker than making a new shaft, cutting keyways, fitting keys, drilling holes, etc. It was only intended for a temporary job, but is still running .



FIGS. 1 AND 2. REPAIR TO PUMP ROD.

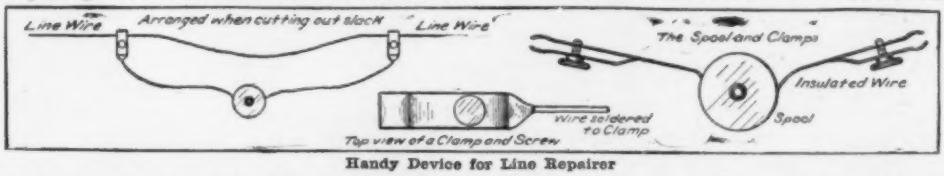
PREVENTS BLOW-HOLES IN STEEL.

To prevent blow-holes in cast steel M. Meslans, of Paris, adds to fluid steel an alloy of aluminum with a metal of the alkali earth group, or with lithium. Aluminum alone does not act upon the nitrogen and hydrogen in the fluid metal. The metals of the alkaline earths and the lithium possess that property, but they are too dear for use alone. An alloy of aluminum and calcium gives the effect of each element, so that carbon monoxide and also nitrogen and hydrogen can be removed.

HANDY DEVICE FOR LINE REPAIRER.

The homemade device shown in the cut will be readily understood by every electrician.

Shown in the drawings is a little arrangement which is handy where it is often necessary to go out on the line and take out the slack, says the American Telephone Journal. Frequently when the repairer pulls up the slack and prepares to make a new splice he cuts the line wide open, and in many cases cuts off a conversation which is taking place. By the use of this little device such annoyances can be avoided. The drawings are almost self-explanatory, but a little description may aid in their understanding. Two clamps are soldered (one at each end) to a piece of insulated wire of a small enough diameter to be easily handled. The wire is then coiled on a spool in such a way that both of the ends are available. When it is desired to cut out slack the wire on the spool is arranged around the point where the line wire is to be cut and connected to the line wire by means of the two clamps. The slack is then pulled and the connection made without interrupting the service. The length of wire to be used will depend on circumstances. Forty feet has been found a handy length.



Handy Device for Line Repairer

NOTES ON STEEL.

The following items are taken from the November issue of Sparks from the Anvil:

In annealing cold rolled steel, gas is turned into the annealing boxes after they are removed from the furnace. The burning of the gas uses up any air that might come in contact with the steel while cooling. By this method the steel comes out of the boxes in bright condition.

* * *

Where a defect occurs in a finished article made of steel, and always in the same place, the steel is not at fault; there is something wrong with the method of making the article.

* * *

The tempering heat is not so high as the annealing heat; the annealing heat is not so high as the hardening heat; and the hardening heat is lower than the forging heat. Always, in practice, bear this in mind. The only exception is in the case of high-speed steel, which is a law unto itself.

* * *

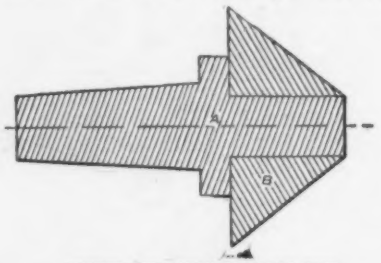
Twist drills hardened in a water bath should be plunged deep enough to harden a short distance on the shank. Water cracks are apt to occur if the drills are held almost stationary in the water. If the drills are soft directly back of the water cracks, it is proof that this portion was held at the water line or so close to it that they did not go into the bath deep enough to harden.

* * *

High speed or self-hardening steel, when required to be cut or broken off into tool lengths, should first be nicked deeply in the bar while hot; or better, should be cut entirely through. Cracks and slivers are liable to be produced if nicked but slightly.

LARGE CENTERS FOR PIPE TURNING.

A is turned from a piece of mild steel to fit the mandrel and roller, with a collar left on to take thrust, while B is turned from cast iron or steel if convenient, and revolves freely on A with the work, which runs much truer than with the usual solid center in a rough pipe.—Engineer.



CENTER FOR TURNING LARGE PIPE.

BLACK INK FOR RUBBER STAMPS.

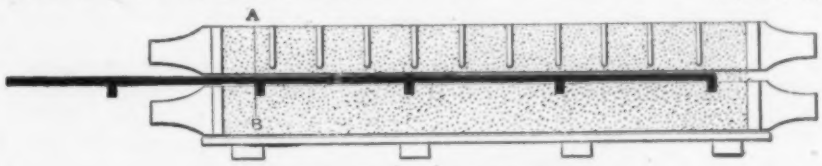
Nigrosin 3 parts, water 15 parts, alcohol 15 parts, glycerine 70 parts. Dissolve the nigrosin in the alcohol, add the glycerine previously mixed with water, and rub well together.

TO BALANCE A LOOSE PULLEY.

A somewhat novel plan for balancing a loose pulley is described as follows in the Woodworker: After it has been bored out ready for use, place it upon a smooth arbor that is solidly supported in place. Wind a cord around the hub, or the rim, according to size of pulley, and give the cord a long, even pull, that unwinds it, giving the pulley the motion due to unwinding process. The inner end of the cord is not tied to the pulley, but left free, except that the cord crosses it to hold the same in place. When the pulley is perfectly balanced it will run a long time without "chattering."

MOLDING SHORTER THAN A PATTERN.

I send you a sketch showing how we made a 5-foot casting off a 9-foot pattern in a 6-foot flask without cutting the pattern, says a correspondent of the American Machinist. We first took the pin off one end of the core, as, the top being a flat surface, a slight shift would not matter; or, to avoid this, we could have bored a hole through the pattern to clear the pin. The pattern was rammed up in the usual way, only the drag was raised from the board the thickness of the pattern, and the pattern projected from the end of the flask. After the cope was taken off and the pattern drawn, we stopped off, as marked by line A B. We did not want to cut the pattern, and we did not have a spare flask long enough to take all the pattern, so this was a case of necessity.



MOLDING SHORTER THAN THE PATTERN.

Cottonwood is worth 40 per cent more than one year ago. It is rapidly becoming scarce and valuable.

WHEN THE WHISTLE BLOWS.

The whirring wheel and the rasking saw
  And the hissing plane are still;
There's silence down in the darksome mine,
  And silence up in the mill.
The hammer and axe are cast aside,
  The shovel and pick repose;
And the sawdust settles in drifts of gold
  When the whistle blows.

Beneath the shade of a spreading tree
  They sit with their dinner pails,
A group of earnest and brawny men
  With muscles as hard as nails.
Their lot is labor from early dawn
  To the daylight's weary close,
With an hour of ease when the clock strikes twelve,
  And the whistle blows.

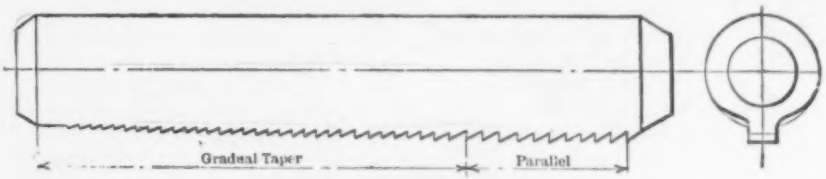
The breeze is fanning their heated brows,
  And to some a dream it brings
Of a cottage small, and a garden gay
  Where the robin builds and sings;
A window curtained in spotless white
  And framed in a crimson rose,
And a smiling face at the open door
  When the whistle blows.

They feel no envy of him who dines
  From damask and silver rare,
On delicate fruits and costly wines,
  With lackeys behind his chair;
For the bread they eat is twice as sweet,
  And the rich man seldom knows
The keen delight of the sons of toil
  When the whistle blows.

—Leslie's Weekly.

TO CUT SMALL KEYWAYS.

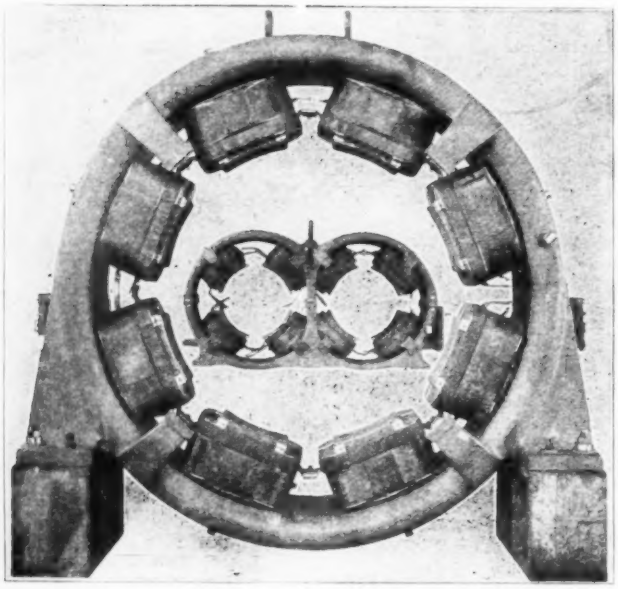
Where small keyways have frequently to be cut in a shop not otherwise equipped the following English kink from the American Machinist may be found useful. A broach, such as shown in the sketch is used, the work being held in a vise, in a bush, and the broach driven through. A broach of this description is very strong and the holes are not injured by it.



COMBINED BROACH AND ARBOR.

A metal roof is said to be positive protection against the building it covers being struck by lightning.

Speed vs. Size



Equivalent High and Low Speed Generators

That an increase in speed requires additional power is illustrated negatively in the cut showing the comparative size of two electric generators. Both are of equal capacity, but owing to the much greater speed of the smaller it produces just as much current as the other. These machines are each 200-kw. capacity; the armature of the larger revolves at 100 revolutions per minute, while the speed of the small one is 900 per minute.

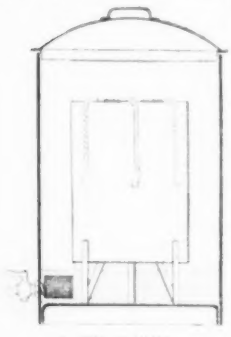
The advantages of the smaller machines are a saving in weight and size. The slow speed machine weighs 35,000 pounds; the high-speed only 9,500 pounds. The larger contains 3,700 pounds of copper more than the other.

Income tax returns show that citizens of Great Britain have invested $5,630,540,500 abroad.

HOME MADE OIL FILTER

Here is another home-made oil filter to add to several already described in these columns. This one is from The Engineer, and the writer says: "I have a filter which works on the principle of capillary attraction that any tinner will make for $5.00.

First have a can with a top made out of heavy tin or galvanized iron 30 inches high by 20 inches in diameter with a faucet 1½ inches from the bottom, and a strainer attached on the inside of the can.



Next have a smaller can 20 inches long by 14 inches in diameter, made with three legs. Place the latter inside of the large can. From a dry goods store obtain three rolls of cotton batting and fold it lengthwise making three folds, six thicknesses, then roll it sidewise and tie it with a string to prevent it from unrolling.

Take the rolls and put one end into the small can and let the other end extend over the side into the large can. Fill the small can with new oil pouring some over the rolls and let it stand for eight hours. Capillary attraction will take about eight inches out of the inner can. Then you can fill it full of dirty oil.

The more rolls of cotton the faster it will filter. Be sure not to have any water mixed with the oil as it will filter water as well as oil.

HOW TO SOFTEN CAST IRON

A German authority says, to soften cast iron, heat the whole piece to a bright glow and gradually cool under a covering of fine coal dust, etc. Small objects are packed in quantities, in a crucible in a furnace or open fire, under materials which when heated to a glow give out carbon to the iron. They should be heated gradually, kept at a bright heat for an hour and allowed to cool slowly. The substances recommended to be added are cast-iron turnings, sodium carbonate or raw sugar. If only raw sugar is used, the quantity should not be too small. By this process it is said that iron may be made so soft that it can almost be cut with a pocket-knife.

PROFESSOR RATEAU ON STEAM TURBINES.

The New Engine that Will Probably Revolutionize Engine Building

At the recent Engineering Conference in London, Prof. Rateau, of Paris, read a paper on the steam turbine. He stated that while C. A. Parsons and the Swedish engineer de Laval are the two foremost names in connection with the development of this type of engine the idea is not new. Its possibilities were indicated by the French engineer Tournaire in 1853 and both Parsons and de Laval have since adopted his suggested plan.

The Engineering Times, London, condenses the following from the paper: As in the case of their hydraulic analogues, steam-turbines may be divided into two principal classes, action and reaction turbines; and each of these classes is subdivided accordingly as the turbine is composed of a single wheel, or of several wheels, traversed successively by the steam in course of expansion. Among re-action turbines (analogous in hydraulics to the well-known "Jonval" turbine), of which, as multiple machines, the prototype is the "Parsons" turbine, the steam is only partially expanded in the distribution, and acquires its full expansion in the movable wheel. The steam, therefore, acts on the blades at once by its pressure and its velocity. The movable wheel is thus subjected on its two faces to pressure of different amount, causing longitudinal thrust, which has to be balanced. These differences of pressure render it necessary to reduce to a minimum the clearance between the movable wheel and the walls by which the steam tends to escape without traversing the blades and so doing useful work. It is indispensable that the distribution of the steam should be effected over the whole circumference of the movable wheel in order to avoid movements of pulsation very prejudicial to efficiency.

In the "action" turbine, on the other hand, the steam only acts on the movable wheels by its velocity. Each wheel revolves in a casing in which the pressure is uniform. Therefore the steam does not produce any sensible longitudinal thrust on the moving parts, which dispenses with the necessity for any special provision to neutralize such thrust. The steam does not tend to rush across the blades in order to pass from one face to the other at the expense of efficiency. It is therefore possible to provide sensible clearance between the moving and fixed parts, and consequently to disregard the wear of the shaft bearing. Further, is is possible, if need be, to project the steam on to one point only of the circumference. Finally, under the same conditions "action" turbines revolve at a less velocity than "re-action" turbines. This renders more easy the direct coupling to the machines worked.

It is not necessary to insist on the well-known advantage possessed by turbines in general of smooth and continuous movement of rotation, but the excessive speed for which they are obliged to be designed in order to meet the speed of flow of the steam constitutes in many cases a serious inconvenience, e. g., in its application to ship propulsion. For a long time this hampered their use for electric installation, but latterly dynamos of very high speed have been constructed, worked by steam-turbines, constituting an outfit of light weight, requiring small space, and although of ample power, of low cost, and, as a consequence of working and upkeep, as simple as can be desired. It follows that for this purpose the steam-turbine may be expected rapidly to supplant the piston-engine.

OIL PRODUCTION IN CALIFORNIA.

The amount of oil consumed on the Pacific coast during the past four years is astonishing, having increased from 4,000,000 barrels in 1900 to over 20,000,000 in 1903. All this oil was taken from California wells.

The oil is found in strata of sand where it is held in suspension like water in a sponge, and lies about 1,060 feet below the surface. Such a well costs $4,000 to put down and in operation. The oil brings 30 cents a barrel at the well. Enterprise gives the following table for estimating the amount of oil supposed to be contained in the oil sand:

One acre of land with sand 100 feet thick contains 155,400 barrels.

One acre of land with sand 200 feet thick contains 310,800 barrels.

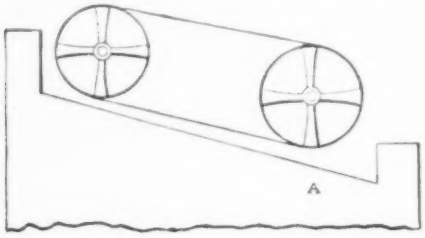
One acre of land with sand 300 feet thick contains 466,200 barrels.

One acre of land, with sand 400 feet thick contains 621,600 barrels.

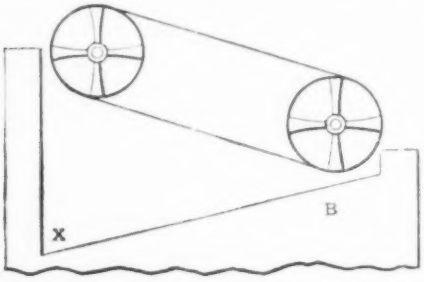
The brains of the Japanese, both male and female, average greater in weight than those of the English or American.

KEEP YOUR BELT PITS DRY.

A certain manufacturing concern which uses a very wide and expensive belt recently had a costly experience. The belt pit, made in the usual manner as shown in the Cut A, filled with water one Saturday night and by Monday morning the belt was nearly ruined. The American Machinist tells how a future accident of the kind may be



prevented. It suggests that belt pits be built as shown in the cut B. Not only would the pit hold a large amount of water before reaching the belt, but at X is placed a trap which allows water to drain to the sewer, but which closes automatically if any back water attempts to enter. In addition a



float should be set to give a continuous alarm on an electric bell in the engine room and office should the water ever reach the danger point.

ECHOES FROM THE IRRIGATION CONGRESS.

The Irrigation Age contains the following in its report of the recent irrigation congress:

Washington correspondent, attempting to be funny at expense of Idaho man, poking at big prize pumpkin: "I say, they raise bigger apples than that where I came from." Idaho man, with contempt: "Apples, is it? Them's not apples, them's huckleberries."

"Best cigar I ever smoked," said the man from Virginia. The Oregon man snickered. "What you laughing about?" demanded the Virginian. "Oh, nothing, but that cigar is made of fresh cured Oregon beet leaf." Virginian puffs away for a while, then: "Well, it goes to show what irrigation will do."

INCANDESCENT LAMP WITHOUT PLATINUM.

L'Electricien, of Paris, says: The Compagnie Generale has been able to entirely abandon the use of platinum in incandescent lamp manufacture. Heretofore attempts have been made to substitute for the platinum one of the ferro-nickel alloys investigated by Dr. Guillaume, but these have not resulted satisfactorily. The method employed by the French firm is based on the use of a special cement, the composition of which is not disclosed. With the cement it is possible to make a perfectly air-tight joint between the leading-in wires and the glass.

HOW TO MAKE PIVOT FILES.

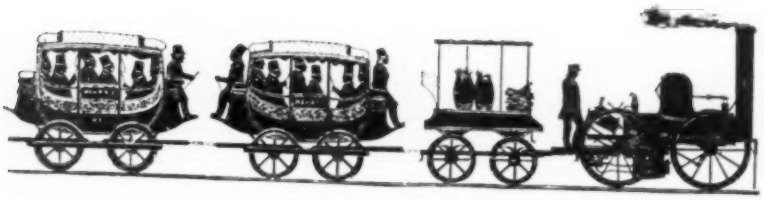
Pivot files, constantly in use by jewelers, may be made from the following directions, according to the Pacific Goldsmith:

Dress up a piece of wood, file fashion, about an inch broad, and glue a piece of fine emery paper upon it. Shape your file then, as you wish it, of the best cast steel, and before tempering pass your emery paper heavily across it several times, diagonally. Temper by heating to a cherry red, and plunging into linseed oil. Old worn pivot files may be dressed over and made new by this process. At first thought one would be led to regard them too slightly cut to work well; but not so. They dress a pivot more rapidly than any other file.

The Noble prize, the blue ribbon of the scientific world, has been awarded by the Swedish Academy of Sciences to Sig. Marconi, the inventor of wireless telegraphy, for making the most important invention of 1902. The prize consists of $40,000 and was provided for in the will of the late Alfred Noble, who died six years ago.

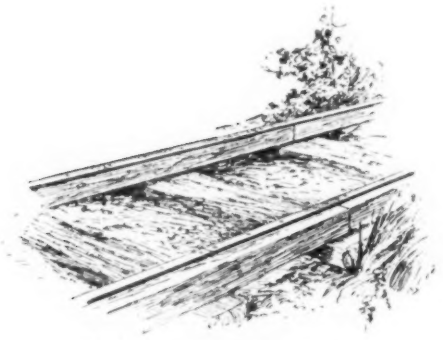
British soldiers with defective eyesight are now required by the war department to wear glasses. This is considered a radical order for conservative England.

Railway Tracks of Early Days



Dewit Clinton Train—1831

In his interesting work, American Railway Transportation, Prof. Johnson devotes a chapter to the first track construction in this country. He says the railway machine consists of three parts, the track, the locomotive and the car. Each had crude beginning, and has reached the present condition of excellence by a long series of improvements. To show how crude these early efforts were he illustrates several types which we reproduce herewith. Many a prominent business man of today rode, when a boy, over these identical mechanical curiosities. Many of the early lines were laid with strap rail on wooden stringers; on others the iron straps were laid on granite sills; and cast rails, in sections 3½ feet long

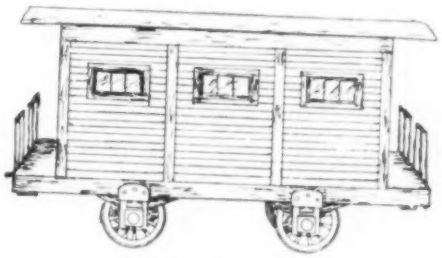


Wood Stringer with Iron Strap

followed. The rolled rail followed next, but the facilities of those days did not permit of rolling a longer rail than 15 feet. Not only were the joints frequent but poorly fastened, and the result was a very rough track, and slow speed, while running off the track was of daily occurrence. The rolled rails weighed 40 pounds to the yard, and were all imported from England until 1844. The cost of iron led to many efforts to substitute wooden rails, and several roads built in this manner were in operation in the South as late as 1850. A thin surface of iron was placed on the wood rails to protect them from wear.

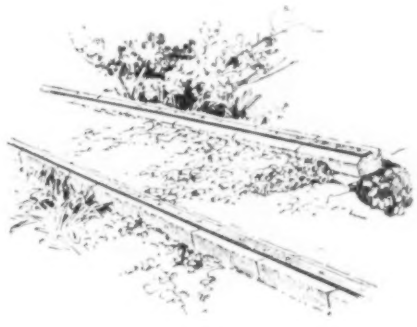
The earlier rolled rails were in the form of an inverted U. The present T-rail was little used during the first 20 years of railroad construction. Steel instead of iron was not common until 1870.

Present day engines and cars are so



Passenger Coach—1835

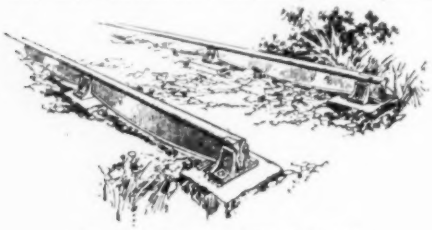
heavy that rails have been enlarged until 100 and 110-pounds to the yard are common; the 100-pound is generally standard on lines of heavy traffic. Thirty feet has been the standard length for some years, although rails 60 feet long have been used



Granite Sills with Iron Strap

to some extent, not so much by steam roads as trolley lines. A rail 60 feet long, weighing 100 pounds to the yard weighs exactly one ton.

The first locomotive actually run upon an



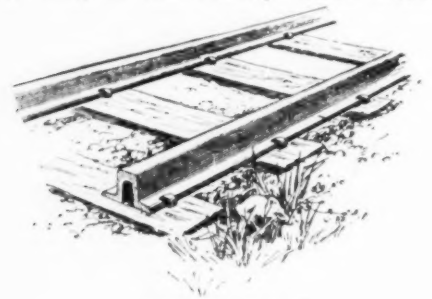
Cast Iron Rails on Granite Blocks

American railroad was the Stourbridge Lion, imported from England in 1829. Locomotive building in this country began in 1830. The Baltimore & Ohio and several other roads which had been built previous

Early Passenger Coach

to this date had been operated with horses.

In 1830 Peter Cooper built the Tom Thumb which weighed only one ton. It was only an experiment. The first locomotive built in this country which actually



Rolled Iron U-Rail

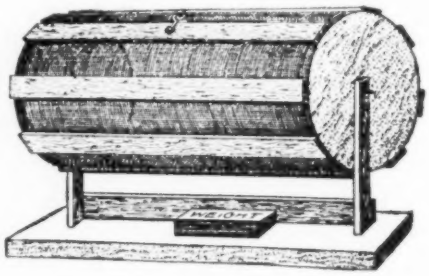
went into practical service was the Best Friend, built in 1830 at West Point Foundry Works. The early cars were equally crude.

AROUND THE WORLD IN AN AUTO.

A New York sportsman will shortly start on a trip around the world in an auto, traveling in his own machine over all the land portion of the journey. He will go from New York to San Francisco, landing at Honolulu, Japan, Hong Kong to Bombay, Italy, Europe and England.

HOME MADE MACHINE FOR WASHING PRINTS.

Amateur photographers will be interested in an arrangement described by one of the correspondents of the Star Weekly. It can easily be made from the following description: Take two pieces of board 10 inches square and make them perfectly round. Then place them 24 inches apart on the floor like two cart wheels, and take some ordinary laths just long enough, 26 inches, to nail them on the outside of each wheel, but before you do this, you must get some mosquito bar 26 inches wide and long enough to reach around the wheels, then place it on each wheel with the outer edge and nail a lath on top of it, then draw the mosquito bar tightly as you go around and



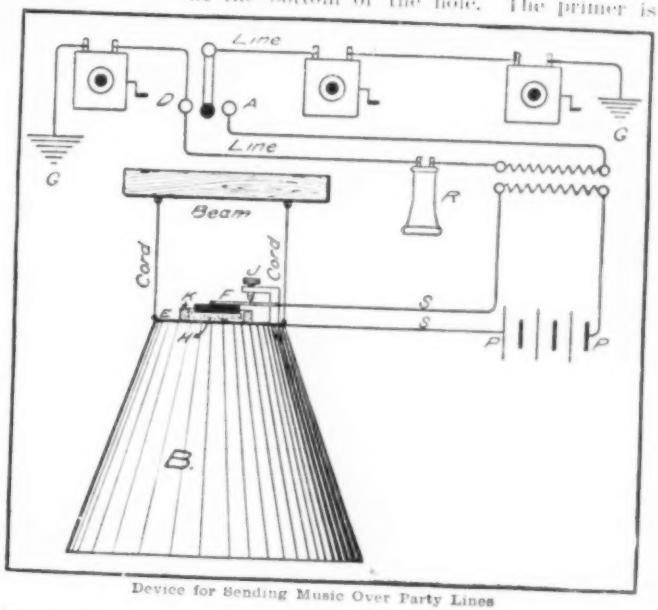
For Washing Prints

nail the laths about three inches apart on the outside of the mosquito bar all around. When you get to the end wind the mosquito bar around the last lath a few times just long enough to reach up closely to the other end, then fasten it with a little hook of wire and leave this as an opening to put in your prints. Then make a little frame 8 inches high, as shown in cut, fastened to the center of each wheel on the outside with a little bolt going through it. At the bottom nail a board, and fasten a little weight on it to hold it down in the water. When all done fill a washtub full of water, or if you have a tank on the place it is better, place your prints on the inside of the washer and keep turning it with the hand to keep the prints in motion. This needs no changing of water and the prints are all done in 30 minutes in the same water. A machine of this size will wash from 75 to 100 4x5 prints at once without touching them with your hand.

A new third-rail device, consisting of a hollow rail with a heating coil in it, to melt snow and ice, has been invented.

HOW TO SEND MUSIC BY TELEPHONE.

The drawing indicates a method that has been used to send music out on a toll line so that all the parties on the line could hear it. The apparatus is crude but has been found to work well and considering the materials from which it was made, has paid for itself many times, says the American Telephone Journal. The transmitter is shown in section, the rest of the circuit being indicated diagrammatically. It will be noted that the transmitting apparatus is suspended from the ceiling by cords. This is done so that the ordinary vibrations of the room will not affect it and also so that it can be easily moved from place to place. B is a tin funnel, 3 inches in diameter at the top and 14 inches in diameter at the bottom. H is granular carbon and F is a block of carbon attached to a strip of metal which is arranged so that the pressure of the carbon block on the granular carbon can be regulated by the tension screw J. The little standard which holds J (which can be an ordinary wood screw) is of seasoned wood. E is a disk of tin which is the diaphragm on which the granular carbon rests and K is a felt ring to confine the carbon to its proper place. The apparatus has been used to send music 50 miles over a party line. The switch D is used to cut the transmitter into the line or to cut the line straight through as is desired. The tension screw J should be adjusted until the listening party says he can hear best.



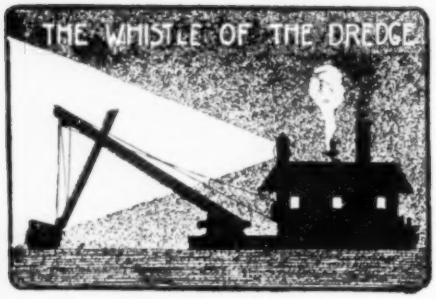
Device for Sending Music Over Party Lines

USING EXPLOSIVES IN MINING.

Discussing the use of explosives in mining operations, J. H. Karku says: "In soft material the action of a high explosive is too local to make it economical, and a weaker and slower one will give much better results. The charge should be concentrated as much as possible at the bottom of the bore-hole, and chambering the hole gives good results. This may be done by placing a small quantity of high explosive at the bottom of the hole. The primer is placed in this, and dry sand poured into the hole. If now the charge is exploded, the hole will be enlarged at the bottom, and a large charge of explosive can be put in, with which the blasting proper is effected. Never attempt to thaw frozen dynamite by roasting, toasting, or baking it, and never put it in heated vessels, boilers, or before fires. Never put a cap on to charge a primer until ready to use it; and after it is capped, never let it out of hand until it is in the hole. Keep caps away from dynamite; they should never come near each other till they are to be used. Never allow smoking near the powder or explosive. Never use a metallic rammer. Do not get nitro-glycerine on the fingers, as it is absorbed and causes headache. Invariably prepare the primer at a distance from the explosive."

California redwood is being used to splendid advantage in the construction of the big pipes used for conveying water to the electric power houses. They cost less than metal pipes and are more durable.

The principal cause of rails creeping on double-track railroads is that the traffic on a given track is all in one direction, and the heavier and faster the trains the more the rails will creep.



Written for Popular Mechanics.

By George Robert Harrison.

Across the lowland's dreary waste,
Where timid marsh-hawks, screaming, fly,
A tall black pipe hurls columns, dark,
Of smoke, upcurling, to the sky.
The long wild grass secretes the grouse,
The rabbit scampers to the hedge,
I hold my ears to half restrain
The shrieking whistle of the dredge.

When autumn sunshine smiles across
The upland meadows where I tread,
When all is calm, I startle at
The sudden signal, "Slack ahead!"
From morning's break till setting sun,
From gloaming till the dawning grey,
At intervals, it weirdly screams,
And slowly, onward, digs its way.

When winds go down, and stars come out,
And soft dews sprinkle o'er the ground,
When all should be sweet restfulness,
I still can hear that dreadful sound.
Like some lone panther's frightful screams,
Or cry of some benighted child,
The old dredge whistle, through the gloom,
Comes to me from the marshes wild.

Across the darkness of the night
I see the headlight's steady glare;
Methinks they are the fiery eyes
Of gaunt hobgoblins prowling there.
My house, asleep, is rudely stirred;
I try to write, but drop my pen;
I long and wait impatiently
Till I may live in peace again.

IF SAHARA WERE A SEA

France Revives Talk of the Possibilities of Transforming the Great Desert

French engineers have declared it is perfectly feasible to convert the desert of Sahara into a vast lake, thus opening to commerce great regions of the interior of Africa, which can now only be reached by long, tedious and dangerous caravan journeys. They say that a large portion of the desert lies below the level of the Atlantic, and that by digging a canal to let in the waters of the ocean the great change could be effected easily and at a cost which would be small compared to the benefits which would accrue.

If the whole desert lay below the level of the Atlantic the flooding of it would create a sea more than four times as big as the Mediterranean; but as the Sahara is composed of elevated plateaus, mountain ranges and depressions, only a part would be covered with water when the waves of the ocean were let in, and the new sea thus formed would be an irregular body of water, probably of about the same size as the Mediterranean. Great commercial cities would at once spring up on its shores and trade and civilization strike at once to the heart of Africa. The sea of Sahara may never become a reality, but, in any event, it is a gigantic and pleasing dream.

AN EARLY BUILT IRON VESSEL.

What is believed to be the first steel vessel ever built lies a wreck in the mud flats off the coast of England. She was named the Trial, and carried 45 tons. The mast was stepped in a tabernacle supported by an iron thwart, to enable its being taken down when passing under the bridges on the river Thames.

The Shipping World, London, says: Some idea of the primitiveness of the arrangements on the Trial can be gathered

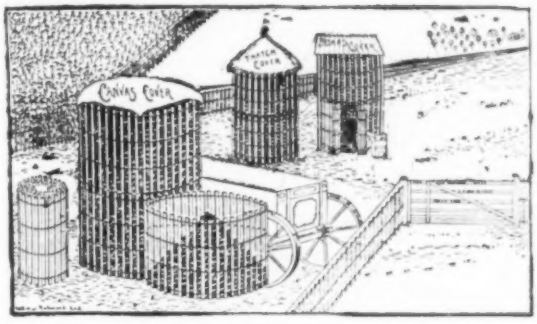
First Steel Ship

from the fact that it was the habit of Captain Benjamin Palmer, the commander, to stow the sail in an open barrel standing on the deck, when it was not in use; and that the crew usually consisted of the captain himself, and a mate. The old Trial, having run the course of her life, now lies half sunk in the mud, just below Coalport Bridge.

M. Curie, the discoverer of radium, has found that the rays of radium color glass a violet blue.

PORTABLE CORN CRIB.

A portable corn crib that can be erected in a few minutes, and built to hold from 100 to 2,000 bushels of corn is one of the recent things of interest to farmers. It is made in sections and can be put together of whatever size and height the owner may desire. It can be taken to any part of the farm, and when filled and covered with canvas makes a very serviceable crib. In summer it serves as a chicken yard.



Portable Corn Crib

EDUCATION FOR EVERY AMERICAN ALMOST FREE.

Great Results or a Philanthropic Undertaking of Noted Professors

Every American who desires may now have an education—no matter what his avocation may be, whether he be rich or poor or whether he live in the country or the city. This results from the successful outcome of a grand and stupendous undertaking on the part of several of America's foremost educators headed by Prof. Eaton of Drexel Institute, Philadelphia. These educators, many of whom, themselves, had risen from the ranks of the poor, put their heads together in the determination that educational advantages should not longer be reserved exclusively for the rich. "Every boy and girl in America who wants an education deserves an education and shall have an education," was their motto. They worked long and silently and now the benefits of their labors are placed at the service of young America.

Through the system which they have devised, 15 volumes, entitled "The Home Study Circle Library," are sent to the student. This is followed up by a series of lessons by correspondence. All is exceedingly comprehensive and by carefully obeying the instructions the student can obtain an American education equal to that of the son of America's richest millionaire. Of course it was necessary to attach a small cost to the service, but it is so little—less than 50 cents a week—that the poorest child in America can avail himself of the magnificent opportunity. The compilation of the volumes and lessons cost more than $30,000, the expense being defrayed by America's public-spirited philanthropists. By a special arrangement with the association thirty beautiful illustrations giving an idea of the elegance of the volumes with complete details of the grand educational offer will be sent free to all who mention Popular Mechanics. In writing address "Home Study Circle Library," 84 Washington avenue, Chicago, Ill.

WHY THEY DON'T WIN.

In a seaport town, on the Atlantic coast,
Two rival hand tubs pump and boast;
At many musters they have raced,
Once in a while one tub gets placed—
The other one "didn't have a show."
"You should have seen how the wind did blow,"
"With the same chance, they'd done better still,
"Twas "too few men," or "the blame was on Bill."
It makes no difference how they play,
Close together or far away,
An even chance was never known
When these two tubs come lumbering home.
Each tub has had her brakes made o'er,
But steel nor brass increased their score.
If Tiger wins her crew is glad,
And Neptune men, of course, are mad;
The other way it's just the same—
Both cannot win, that's very plain.
We've heard so much about these tubs,
Which one's the best. Ah! there's the rub.
A dual meet t'would seem 'bout right,
Both pick their men, prepared to fight;
An equal number on the brakes,
Three judges fair, no rubber tapes;
Ten minutes each, let both tubs try,
'Twould seem enough to you and I.
Some say the tubs are just alike,
Same water ways, same suction pipe;
Some like the fifth hole, some the third,
Both pro and con is oft times heard.
The nozzle, too, is not used right,
Too large, or small, but never right
Each tub at home works out quite well,
Now let us hope they'll have this meet,
Both tubs prepared, all on their feet,
The distance played will prove to all,
Which one of them "Goes to the wall."
—Newburyport (Mass.) Herald.

Metal Industry says: Steel of a quality equal to that made in crucibles has never been reached by the open-hearth or Bessemer process, and brass always gives better results when melted in crucibles.

"The treatment of steel is the study of a lifetime."

Weaving Silk in America

Weaving silk in America is becoming an important industry since the advent of improved machinery, and the passing of the old spinning wheel and hand loom, whose clatter and click were once familiar sounds in this country. The giant power loom in the great modern factory has supplanted the hand loom, and skilled men instead of women operate them.

The hand loom departed almost simultaneously with the old-fashioned spinning-wheel. The power loom does more than ten times the work of the hand loom, and it was the power loom that made it possible for Americans to become noted as weavers of silk.

The most remarkable invention known to silk weaving is the "jacquard loom." This is not really a loom, but an attachment that can be adapted to any loom. This is the machine which produces, according to the cards designed for it, the most elaborate and beautiful conceptions in silk. Jacquard apparatus is a device applied to looms for weaving figured goods. It consists of a mechanism controlled by a chain of variously perforated cards, which cause the warp threads to be lifted in the proper succession for producing the required figure. The perforated cards are called jacquard cards, and a loom equipped with the jacquard apparatus is called a jacquard loom. All derive their name from Joseph Marie Jacquard (pronounced zha-kar'), the noted French inventor, who died in 1834. The "Dobby," a smaller machine, is utilized for working fancy stripes and what are known as "shaft" effects. Jacquard tie silks are always more expensive than the "shaft," or plain weave fabrics, as the cost of erecting jacquard looms and equipping them with new patterns is greater.

The pattern worked out by the jacquard is made by talented designers; hundreds of cards have to be cut for the loom, so that the pattern may be woven according to the water color design of the artist, and the loom equipment is expensive. For the plain goods the design or pattern may be worked out by the weaving foreman, under whose direction the loom can be readily changed from one pattern to another at small expense as compared with the cost of the jacquard work.

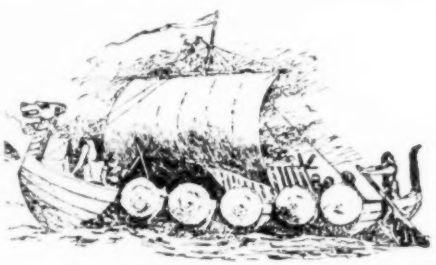
Very beautiful designs in silk are also obtained by warp printed patterns. These designs are printed upon the warps which pass through a series of rollers engraved with the pattern, and the warps are afterwards put into the looms and woven or embellished with stripes and bars to add to their beauty.

However the silk fabric may be treated, whether the weave be plain or figured, the finishing is always important and forms a separate department. The fabric is subjected to a number of processes, sprayed with liquid glue, gum arabic, mixed with soap, is then passed over hot rolls or calenders and comes out brilliant with a firm body and as smooth as can well be imagined. The silk fabric is then taken to the shipping room, where it is folded, wrapped and packed for delivery to the salesroom.

America now manufactures 80 per cent of the silk used for dress goods, broad silks, including tie silks, linings, etc., and 85 per cent of the ribbons used in the United States. According to the last census report, the United States manufactures in round numbers $107,000,000 worth of silk goods and imports less than $27,000,000 worth from Europe. A few years ago we were entirely dependent upon France and Italy for our silk. America imports $45,000,000 worth of raw silk annually. More raw silk is sold in New York each year than is consumed in France, the greatest silk consuming country in Europe. The American looms turn out 6,000,000 yards of silk annually. In this production Connecticut leads, Massachusetts is second and New Jersey third.

QUEER SHIP DUG UP IN IRELAND.

A queer ship was recently dug up in Ireland. Strange to say it was not made by



Queer Irish "Viking" Ship

the Norsemen, much as it resembles a Viking ship. It is the work of the ancient seamen of Ireland.

The Forests are the Nation's Life

The Most Vital Internal Problem in the United States Can Only be Solved by Trained Foresters

By Theodore Roosevelt

I believe that there is no body of men who have it in their power today to do a greater service for the country than those engaged in the scientific study and practical application of approved methods of forestry for the preservation of the woods of the United States. The forest policy of any country must be an essential part of its land policy. The object of our forest policy is not to preserve the forests beause they are beautiful, though that is good in itself, nor because they are refuges for the wild creatures of the wilderness, though that, too, is good in itself; but the primary object of our forest policy, as of the land policy of the United States, is the making of prosperous homes. It is part of the traditional policy of home making of our country. Every other consideration comes as secondary. The whole effort of the government in dealing with the forests must be directed to this end, keeping in view the fact that it is not only necessary to start the homes as prosperous, but to keep them so. That is why the forests have got to be kept. You can start a prosperous home by destroying the forests, but you cannot keep it prosperous that way.

Forestry means making the forest useful not only to the settler, the rancher, the miner, the man who lives in the neighborhood, but, indirectly, to the man who may live hundreds of miles off down the course of some great river which has its rise among the forest-bearing mountains.

The forest problem is in many ways the most vital internal problem in the United States. The more closely this statement is examined the more evident its truth becomes. In the arid region of the west agriculture depends first of all upon the available water supply. In such a region forest protection alone can prevent the great and destructive floods so ruinous to communities farther down the same streams that head in the arid regions.

The relation between the forests and the whole mineral industry is an extremely intimate one; for, as every man who has had experience in the west knows, mines cannot be developed without timber—usually not without timber close at hand. In many regions throughout the arid country ore is more abundant than wood, and this means that if the ore is of low grade the transportation of timber from any distance being out of the question, the use of the mine is limited by the amount of timber available.

The very existence of lumbering, of course—and lumbering is the fourth great industry of the United States—depends upon the success of our work as a nation in putting practical forestry into effective operation.

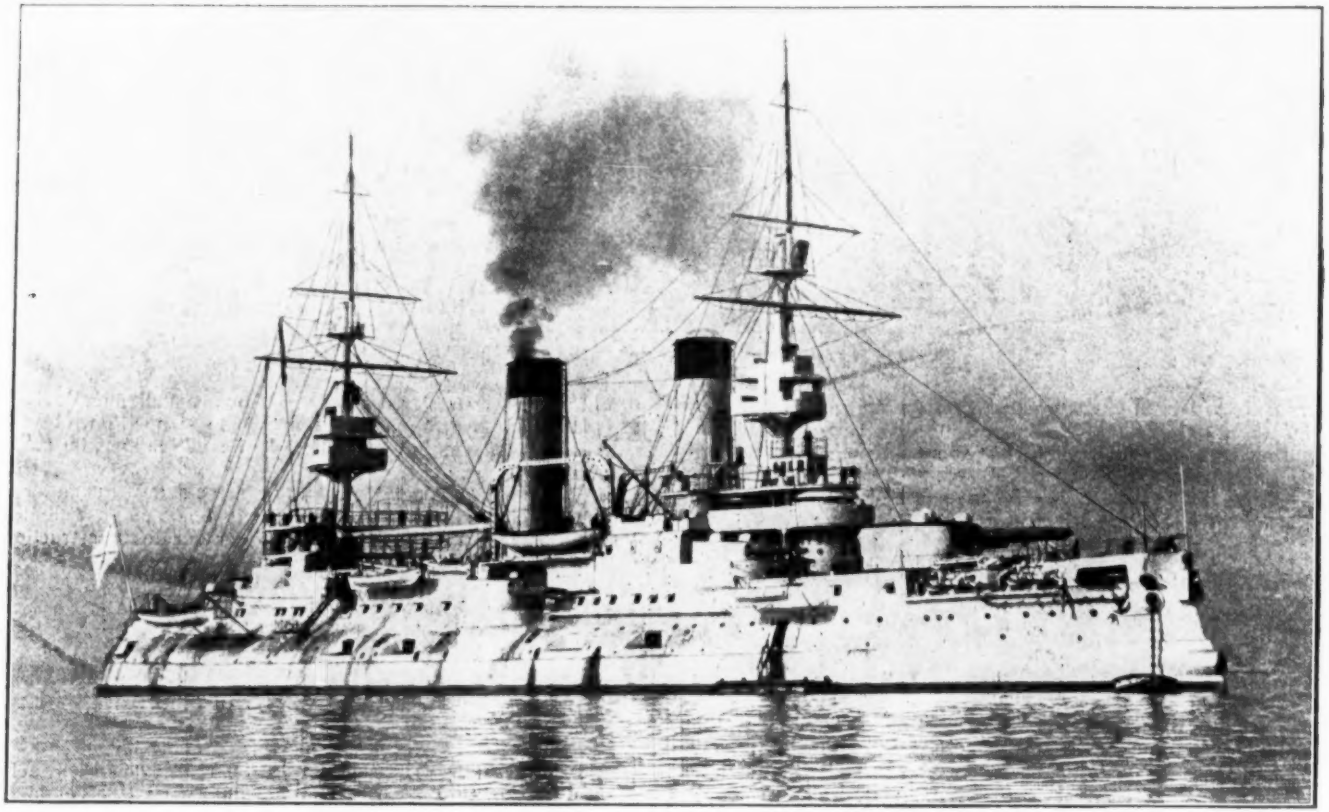
As it is with mining and lumbering, so it is, only in a less degree, with transportation, manufactures, commerce in general. The relation of all these industries to forestry is of the most intimate and dependent kind. It is a matter of congratulation that so many of these great industries are now waking up to this fact; the railroads especially, managed as they are by men who are compelled to look ahead, who are obliged by the very nature of their profession to possess a keen insight into the future, have awakened to a clearer realization of the vast importance of the economic use both of timber and of forests.

Even the grazing industry, as it is carried on in the great west, which might at first sight appear to have little relation to forestry, is nevertheless closely related to it, because great areas of winter range, available and good for winter grazing, would be absolutely worthless without the summer range in the mountains where the forest reserves lie.

The forest resources of our country are already seriously depleted. They can be renewed and maintained only by the co-operation of the forester with the practical man of business in all his types, but, above all, with the lumberman.

The United States is exhausting the forest supplies far more rapidly than they are being produced. The situation is grave and there is only one remedy. That remedy is the introduction of practical forestry on a large scale, and, of course, that is impossible without trained men, men trained in the closet, and also by practical field work under practical conditions.

Russia's Newest Naval Terror



First-Class Battleship "Cesarovitch."

Russia's Monster Battleship--The "Caesarovitch"

It has been said that Russia's aim is to rule the world; that the acquisition of Corea is only the beginning of that nation's colossal scheme that will soon absorb China and work revolutionary changes on the map and in history.

Probably it is this ambition that has been the hidden cause of the great and formidable warships that have silently been added to the Russian navy of recent years. The newest and most terrible of these is the "Caesarovitch." This monster is a battleship of the first class that weighs 13,110 tons, has 16,300 horsepower and makes a speed of 18 knots an hour. Its armament consists of four 12-inch 40 caliber guns; twelve 6-inch rapid fire 45 caliber guns in pairs in six turrets; twenty 12-pounders, 12 in casemates amidships; twenty 3-pounders, six 1-pounders and four maxims. There are six torpedo tubes, one in the stem, one above water in the stern, two above water forward, and two submerged broadside.

The following data as to the ship's armor protection is contained in the Journal of the United States Artillery:

"Armor Protection:—Water-line belt k. s. 6.5 feet wide, 1 foot 8 inches above water, 9.75-inch amidships, tapering to 6-inch at lower edge, 5.75-inch at ends; above this another belt 6-inch k. s. tapering to 4.75 in. at ends, extending 5.5 feet above main belt. Turrets for heavy guns, 10-inch; for 6-inch guns, 6-inch; casemates, 3-inch; armored deck, upper flat, 2-inch; lower, amidships, 4-inch."

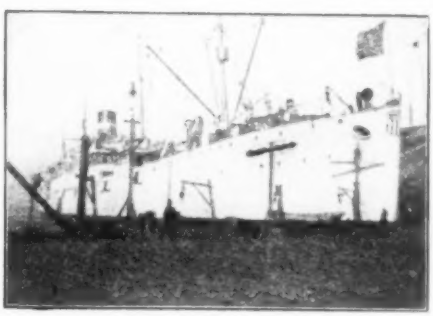
Ignominy of a Noble Government Transport

The "Grant" Being Transformed into Mammoth Dredge to Dig Mud---Will be the Largest in the World

No longer will the big transport "Grant" carry United States troops to plant the stars and stripes in far off ports. The transport, which in building and repairs cost $2,000,000 and which did such noble service between San Francisco and Manila during the Spanish war, is now being turned into a mammoth dredge to dig mud from the mouth of the Columbia river. It is quite a fall in dignity for the veteran vessel, but it will doubtless serve the nation well and with distinction in its new though less exalted avocation.

The "Grant" will become the largest dredge in the world, and will be unlike any other dredge ever built. The enormous engines with which the transport is equipped will be utilized in working the great dippers, for the "Grant" will be known as a "dipper" dredge.

It is the problem of digging a ship's channel into the open sea at the Columbia's mouth that caused congress to appropriate money for converting the "Grant" into a dredge. Just such a powerful machine is needed in this difficult work, where it seems the ocean is constantly endeavoring to shoal the channel. Some years ago the government built a jetty which, starting just south of the river's mouth, extended for several miles into the ocean. This jetty has done good work in deepening the channel, but it was not sufficient for the demands of the growing commerce of the Pacific coast. The new work, for which congress has made an appropriation, will include an immense amount of dredging by the "Grant" and the extension of the jetty three miles further out. Several years will be consumed in the improvements.



U. S. Transport Grant Converted into a Dredge

The "Grant" is now at the Mare Island naval station, California, undergoing the transformation.

WOMEN AS INVENTORS

Hundreds of patents are taken out each year by women, and patent attorneys say that scores of valuable inventions originated in the bright minds of women never are heard from because a woman is much less inclined to think of applying for a patent than a man. It is also stated that a larger proportion of patents granted women prove successful money makers than an average equal number issued to men.

The United States Patent Office was opened in 1790, but there is no record of any patents being granted to a woman until 1809. This was not for a corset, but the second patent to a woman, which was in 1815, was, and ever since about one-sixth of all the patents to women are for corsets. The greater part of the balance are for articles pertaining to wearing apparel, personal adornment, and household utensils and articles.

In the mechanical line can be found hundreds of useful inventions which have been patented by women. These include washing machines, sewing machines and attachments, dish washing machines, wash boilers, egg beaters, steaming apparatus for shaping pantaloons, pea sheller, type writers, clocks, toys; while one of the best army canteens yet devised was a woman's idea and patent.

Many a woman has reaped a large fortune from a patent, which was the result of an ability to realize the advantages to be secured by some slight improvement in some old method. Many others have thoughtlessly given a valuable idea to some one who immediately set to work to secure the prize and reaped the reward.

WHAT INVENTIONS HAVE DONE.

The natural resources of America have made possible the rapid growth in population, industry and wealth which has amazed the world, but without the inventor how far short of present advance would we have been today? If a thing is particularly hard to do, or a great many articles of one kind are desirable, the Yankee genius soon finds a way to do it with the least labor, in the shortest time and at the least expense. The history of American invention is an intensely interesting study, in which great fortunes gained through successful inventions, stand out in bold relief at frequent intervals.

REGARDING CHARGES FOR INFORMATION.

To the Editor: Is it customary for patent attorneys to make a charge for reply to a letter of inquiry as to the advisability and cost of taking out a patent. I am not near any large city where I can consult a patent lawyer personally, but do not want to incur a large fee without knowing just what the cost will amount to.—C. E. T.

Answer:—Our reader need not hesitate to correspond with any reputable patent attorney regarding the expense of securing a patent, nor will attorneys in good standing make any charge for information as to the amount of research, etc., necessary to prepare the application. Any of the patent attorneys advertising in this magazine will cheerfully answer any reasonable question necessary to enable the inquirer to decide whether it is worth while to patent or not; and will send much valuable information entirely free to inventors who contemplate taking out papers.

NEW MEXICAN PATENT LAWS.

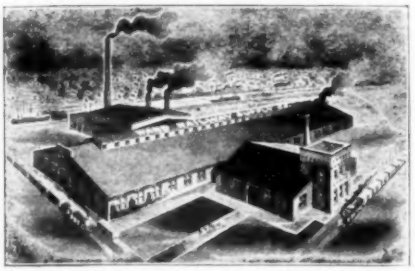
Mexico has adopted new regulations respecting the granting and use of patents in that country. A copy of the new patent laws is on file in Washington at the department of Commerce and Labor, together with a translation in English, where it can be examined by interested parties.

The Book and Newsdealer, New York, says in its November issue:

"Popular Mechanics is almost tickled to death over its change from weekly to monthly publication. We have had reports from about twenty news dealers here in the city, and every one of them sold out their September supply in from three to ten days, and nearly all of them had taken double or more the number they had previously been selling of the weekly. Reports from other news dealers in different parts of the country tell the same story. The edition for October was 40,000—an increase of 8,000 since July. Looks like reaching the 50,000 mark in January."

A modern power house where reciprocating steam engines, gas engines and steam turbines will all be running will form one of the most interesting exhibits to mechanics at the St. Louis fair.

A SOUND INVESTMENT



The Railroads of America are earning more money than ever before in the history of the country, largely because they have reduced the cost of operation to a minimum by the introduction of every device which will save expense and increase the efficiency of their service.

That is why you never hear of a Railway Supply Company in difficulties. That is why such companies are usually owned by a few rich men who reap the harvest which comes from the tremendous demand for patented devices and supplies to be used on the 194,000 miles of railroad in this country alone.

WARD RAILWAY SUPPLY COMPANY

This company, which owns the factory illustrated above, owns and controls eight distinct railway and steamboat appliances, besides other valuable trade already established, can with economical manufacturing and management earn an annual profit of over $250,000.00.

It is to enable us to accomplish this that we have increased our original capital from $25,000.00 to $300,000.00.

Our whole financial plan is moderate and simple. It means that whereas certain of our patented railway appliances are now being manufactured for us by other concerns, we propose to enlarge our facilities and manufacture these appliances ourselves and give the manufacturers' profit, which is very large indeed, to our own stockholders.

That is all there is to it.

Of the $300,000.00 stock we have placed in the Treasury of the Company $150,000.00, and the proceeds of this sale of stock belongs solely to the Company. We have no watered stock and no promoter's stock.

THIS TREASURY STOCK WE OFFER AT PAR

It will earn 30 per cent the first year. This expectation is well founded. Manufacturing enterprises in our line conducted on businesslike principles and without the excessive capitalization, so common of late, always yield large returns. There are hundreds of such companies that you do not hear about because their securities are not listed on Stock Exchanges.

WE HAVE NO PREFERRED STOCK AND NO PREFERRED STOCKHOLDERS

We sell to railroads; they never fail to pay for their supplies. Don't forget that, and don't forget that you cannot say that of any other business, not even banks. They do not always pay their obligations.

IF YOU HAVE ONLY A SMALL INCOME WHY NOT INCREASE IT 100 PER CENT

Shares are $50.00 each. Send us $100.00 if you have no more. This will earn you $30.00 the first year, $60.00 the second and $100.00 the third year. Write for prospectus.

Ward Railway Supply Co., 267 Dearborn St. Chicago, Ill.

BOWLING GIVES HEALTH AND STRENGTH.

Mechanical construction of the balls counts for more than many persons realize in skillful bowling. Perfect balls are difficult to obtain and but few manufacturers seem to have discovered the secret of their construction.

Bowling, like all other athletic sports, has its benefits and injuries to the human system. In bowling ten pins, however, with the finger hole ball, the finger or thumb will give out before you can injure any part of your body. Bowling brings into play every muscle of the body without overtaxing the strength or developing one organ at the expense of another, physicians are giving it their unqualified endorsement.

Nothing enfeebles and lowers the bodily mental tone more than entire giving up of all the energies to one single pursuit; the overworked merchant, or professional man, however, has only to bestow an occasional day upon any of the various athletic exercises within his reach and he speedily recovers himself and instead of losing way in the course which he is pursuing he is enabled to do more than make up the lost time which his absence has occasioned by the increased vigor which his change of scene and occupation has given him. This is so well understood in our large cities that many of our first merchants make a regular practice of devoting one or two days each week to some kind of amusement. They take, however, to various methods, but all act upon the principle of unbending the bow to enable it to regain its spring.

Bowling has become a reputable and fashionable recreation and to become a good bowler is recognized as an accomplishment not to be despised. To reach proficiency requires practice, study, thought, the application of art and careful attention to the various requirements of the pastime, especially to that of the delivery of the ball.

Some claim bowling is the only athletic sport that does not require an instructor, that no two bowlers bowl alike and that you have nothing to learn. This is a mistaken idea. If beginners were instructed as to how to start and what kind of a ball to use they could secure better results and without injury to themselves.

Great preparations are now being made for the national bowling tournament to be held in Cleveland in February. Contracts for the alleys have been let to the Brunswick-Balke Collender Co.

MUD DEPOSIT OF THE MISSISSIPPI.

Thousands of tons of our very richest soil, equal to hundreds of acres of the best farming land, are washed away and carried down to the Gulf each year by the Mississippi river.

In a recent lecture before the Franklin Institute Prof. Lewis M. Haupt stated:

It has been estimated that the volume of sediment carried into the Gulf each year varies from 250,000,000 to 278,000,000 cubic yards, but it is also stated that the banks are constantly caving at the rate of about 9 acres per mile of river and that their average height is from 30 to 45 feet, which would contribute about 332,000,000 cubic yards to the bed of the stream, independently of the amount fed by the tributaries, which is no doubt much more, so that the net amount of sediment left in the bed would exceed that deposited in the Gulf, if it be prevented from spreading beyond the bank by levees. Hence it must follow that unless the ejecta are equal to the injecta the excess must contribute to elevation. This may readily be accepted as a fact when it is seen that a single flood may cause deposits on a level amounting to from 6 to 12 inches of mud.

BOOKS OF THE MONTH REVIEWED.

PRACTICAL JOURNALISM, by E. L. Shuman, 165 pages, D. Appleton & Co., New York. Price $1.25. A book by an old-time newspaper man, on how a daily newspaper is made. Interesting to all and instructive to the young man or woman who has a desire to engage in daily newspaper work. Several leading dailies are taken as examples for analyzing the organization and operation of the editorial department.

AMERICAN RAILWAY TRANSPORTATION, by Emory R. Johnson, Ph. D., 434 pages, illustrated. D. Appleton & Co., New York. Price $1.50. This work defines transportation, in the introduction and then discusses general railway and steamship problems under four divisions: The American Railway System; The Railway Service; Railways and the Public, and Railways and the State. Professor Johnson has placed in readable and instructive language a large amount of information and data, which will be found extremely helpful to any student of transportation problems.

SPECIAL OFFER TO POPULAR MECHANICS READERS: Many people believe that instruction in electricity cannot be given outside the class room. To demonstrate the standard, scope and methods of our instruction, we have bound up four representative text books of our Electrical Engineering Course in a handsome linen cover under the title of "Practical Lessons in Electricity," and will send one copy for 75 cents to every reader of Popular Mechanics who will send us the names of two friends interested in electricity, mechanics, civil engineering, textiles, or architecture. The books are easily worth $3. Address room 108 G., American School of Correspondence, Armour Institute of Technology, Chicago, and be sure to mention Popular Mechanics.

"Want" and "For Sale" Ads. 2 cents per word, payable in advance. Replies may be sent to a number, care Popular Mechanics, and will be forwarded promptly without extra charge.

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1¼ H. P. engine, $30.00.
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MISCELLANEOUS—CONTINUED.

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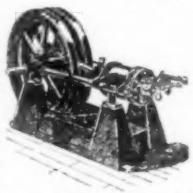

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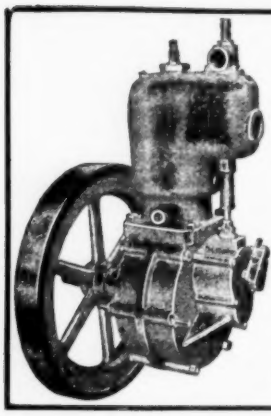

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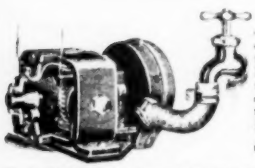

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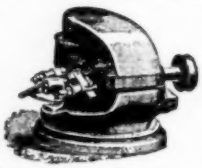

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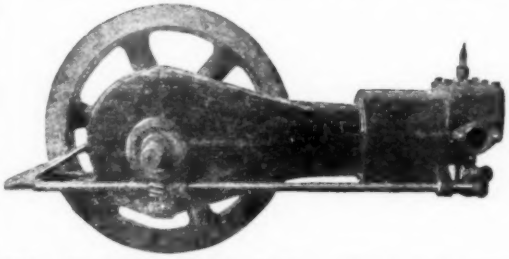

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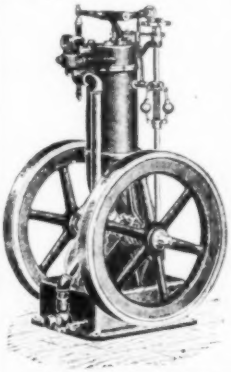

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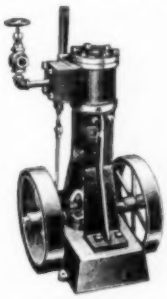

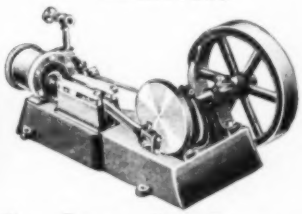

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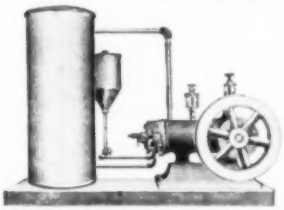

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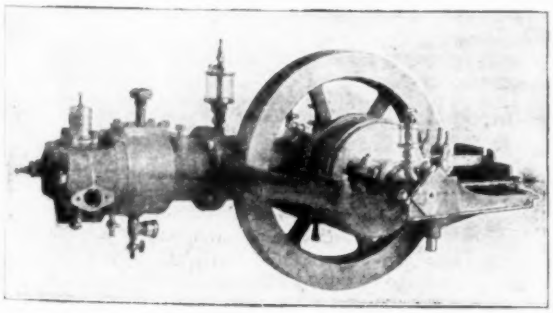

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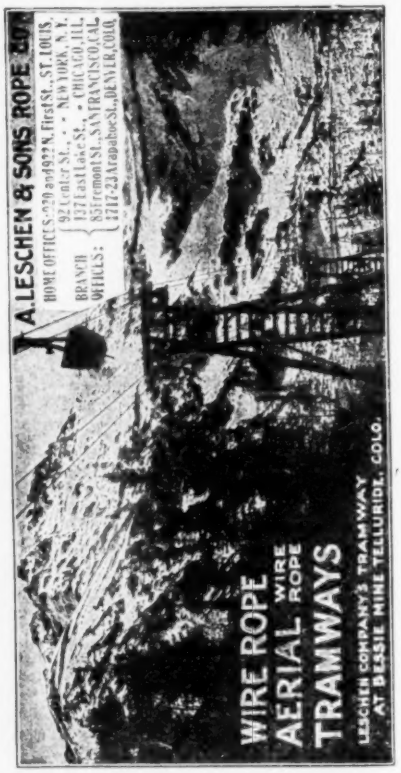
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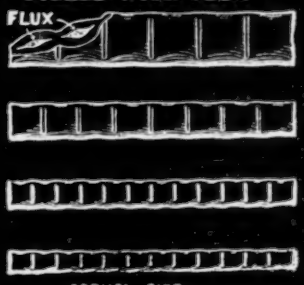

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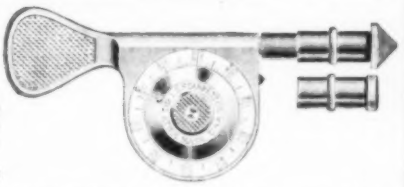

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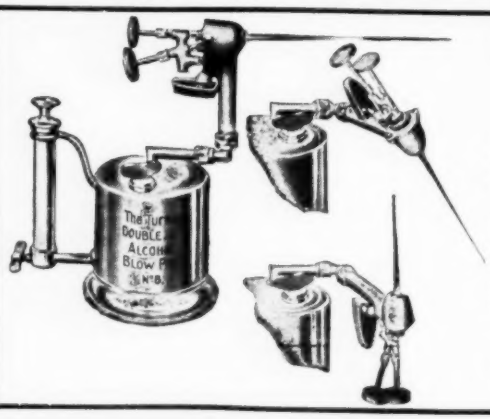

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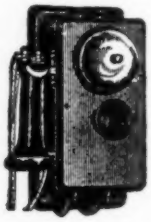

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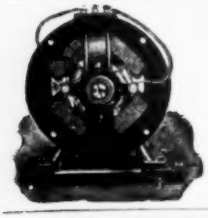

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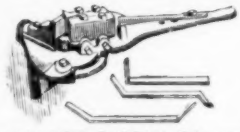

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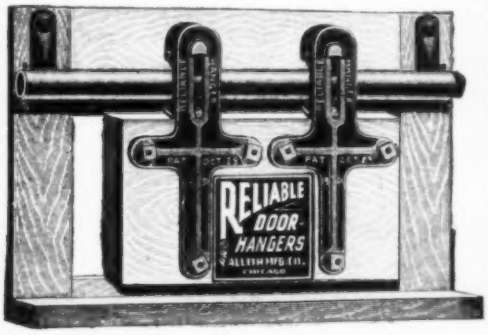

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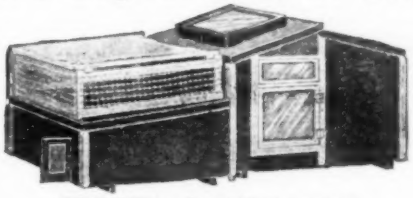

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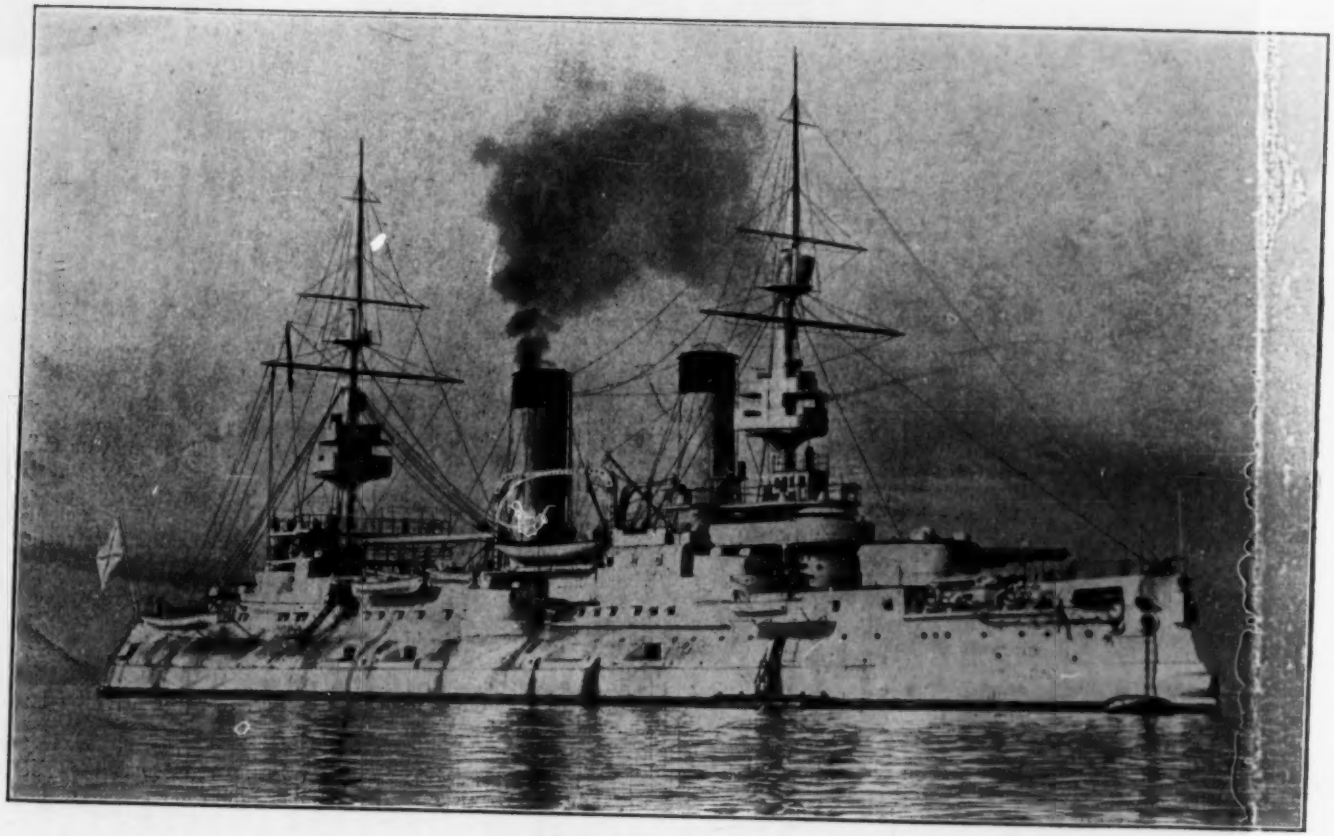


First-Class Battleship "Cesarovitch."

Russia's Monster Battleship--The "Caesarovitch"

It has been said that Russia's aim is to rule the world; that the acquisition of Corea is only the beginning of that nation's colossal scheme that will soon absorb China and work revolutionary changes on the map and in history.

Probably it is this ambition that has been the hidden cause of the great and formidable warships that have silently been added to the Russian navy of recent years. The newest and most terrible of these is the "Caesarovitch." This monster is a battleship of the first class that weighs 13,110 tons, has 16,300 horsepower and makes a speed of 18 knots an hour. Its armament consists of four 12-inch 40 caliber guns; twelve 6-inch rapid fire 45 caliber guns in pairs in six turrets; twenty 12-pounders, 12 in casemates amidships; twenty 3-pounders, six 1-pounders and four maxims. There are six torpedo tubes, one in the stem, one above water in the stern, two above water forward, and two submerged broadside.

The following data as to the ship's armor protection is contained in the Journal of the United States Artillery:

"Armor Protection:—Water-line belt k. s. 6.5 feet wide, 1 foot 8 inches above water, 9.75-inch amidships, tapering to 6-inch at lower edge, 5.75-inch at ends; above this another belt 6-inch k. s. tapering to 4.75 in. at ends, extending 5.5 feet above main belt. Turrets for heavy guns, 10-inch; for 6-inch guns, 6-inch; casemates, 3-inch; armored deck, upper flat, 2-inch; lower, amidships, 4-inch."

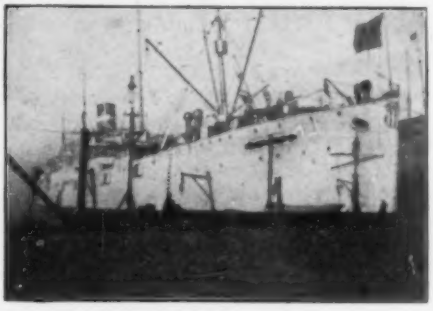
Ignominy of a Noble Government Transport

The "Grant" Being Transformed into Mammoth Dredge to Dig Mud---Will be the Largest in the World

No longer will the big transport "Grant" carry United States troops to plant the stars and stripes in far off ports. The transport, which in building and repairs cost $2,000,000 and which did such noble service between San Francisco and Manila during the Spanish war, is now being turned into a mammoth dredge to dig mud from the mouth of the Columbia river. It is quite a fall in dignity for the veteran vessel, but it will doubtless serve the nation well and with distinction in its new though less exalted avocation.

The "Grant" will become the largest dredge in the world, and will be unlike any other dredge ever built. The enormous engines with which the transport is equipped will be utilized in working the great dippers, for the "Grant" will be known as a "dipper" dredge.

It is the problem of digging a ship's channel into the open sea at the Columbia's mouth that caused congress to appropriate money for converting the "Grant" into a dredge. Just such a powerful machine is needed in this difficult work, where it seems the ocean is constantly endeavoring to shoal the channel. Some years ago the government built a jetty which, starting just south



U. S. Transport Grant Converted into a Dredge

of the river's mouth, extended for several miles into the ocean. This jetty has done good work in deepening the channel, but it was not sufficient for the demands of the growing commerce of the Pacific coast. The new work, for which congress has made an appropriation, will include an immense amount of dredging by the "Grant" and the extension of the jetty three miles further out. Several years will be consumed in the improvements.

The "Grant" is now at the Mare Island naval station, California, undergoing the transformation.

WOMEN AS INVENTORS.

Hundreds of patents are taken out each year by women, and patent attorneys say that scores of valuable inventions originated in the bright minds of women never are heard from because a woman is much less inclined to think of applying for a patent than a man. It is also stated that a larger proportion of patents granted women prove successful money makers than an average equal number issued to men.

The United States Patent Office was opened in 1790, but there is no record of any patents being granted to a woman until 1809. This was not for a corset, but the second patent to a woman, which was in 1815, was, and ever since about one-sixth of all the patents to women are for corsets. The greater part of the balance are for articles pertaining to wearing apparel, personal adornment, and household utensils and articles.

In the mechanical line can be found hundreds of useful inventions which have been patented by women. These include washing machines, sewing machines and attachments, dish washing machines, wash boilers, egg beaters, steaming apparatus for shaping pantaloons, pea sheller, type writers, clocks, toys; while one of the best army canteens yet devised was a woman's idea and patent.

Many a woman has reaped a large fortune from a patent, which was the result of an ability to realize the advantages to be secured by some slight improvement in some old method. Many others have thoughtlessly given a valuable idea to some one who immediately set to work to secure the prize and reaped the reward.

WHAT INVENTIONS HAVE DONE.

The natural resources of America have made possible the rapid growth in population, industry and wealth which has amazed the world, but without the inventor how far short of present advance would we have been today? If a thing is particularly hard to do, or a great many articles of one kind are desirable, the Yankee genius soon finds a way to do it with the least labor, in the shortest time and at the least expense. The history of American invention is an intensely interesting study, in which great fortunes gained through successful inventions, stand out in bold relief at frequent intervals.

REGARDING CHARGES FOR INFORMATION.

To the Editor:—Is it customary for patent attorneys to make a charge for reply to a letter of inquiry as to the advisability and cost of taking out a patent. I am not near any large city where I can consult a patent lawyer personally, but do not want to incur a large fee without knowing just what the cost will amount to.—C. E. T.

Answer:—Our reader need not hesitate to correspond with any reputable patent attorney regarding the expense of securing a patent, nor will attorneys in good standing make any charge for information as to the amount of research, etc., necessary to prepare the application. Any of the patent attorneys advertising in this magazine will cheerfully answer any reasonable question necessary to enable the inquirer to decide whether it is worth while to patent or not; and will send much valuable information entirely free to inventors who contemplate taking out papers.

NEW MEXICAN PATENT LAWS.

Mexico has adopted new regulations respecting the granting and use of patents in that country. A copy of the new patent laws is on file in Washington at the department of Commerce and Labor, together with a translation in English, where it can be examined by interested parties.

The Book and Newsdealer, New York, says in its November issue:

"Popular Mechanics is almost tickled to death over its change from weekly to monthly publication. We have had reports from about twenty news dealers here in the city, and every one of them sold out their September supply in from three to ten days, and nearly all of them had taken double or more the number they had previously been selling of the weekly. Reports from other news dealers in different parts of the country tell the same story. The edition for October was 40,000—an increase of 8,000 since July. Looks like reaching the 50,000 mark in January."

A modern power house where reciprocating steam engines, gas engines and steam turbines will all be running will form one of the most interesting exhibits to mechanics at the St. Louis fair.